Electronic Communications Committee (ECC)
within the European Conference of Postal and Telecommunications Administrations (CEPT)

THE USE OF THE FREQUENCY BANDS 27.5-30.0 GHz AND 17.3-20.2 GHz BY SATELLITE NETWORKS

Gothenburg, September, 2010

0 EXECUTIVE SUMMARY

This report illustrates the increasing role of satellite communications and the availability of Ka[1] band satellite services in CEPT, particularly for commercial applications. Technological advances and reduced equipment costs are such that satellite service providers are now targeting the consumer market for the provision of broadband access, IPTV and other multimedia applications. The delivery of consumer broadband services using Ka band satellites is particularly suited to rural and sub-urban areas where the availability of alternative services such as DSL or cable is not prevalent. Ka band systems employ "spot beams," rather than a single coverage area over an entire continent, allowing a more efficient use of the available bandwidth. In addition, the costs of user equipment, relative to Ku[2] band, will drastically decrease since systems do not require very large dishes to produce high speed communications and the cost of modems drops significantly with higher production numbers. The availability of Ka band satellite services is particularly important as they can contribute to fulfilling the objective of bridging the digital divide. The deployment of smaller and portable satellite user terminals, intended for rapid installation and operation, will become increasingly ubiquitous. The rapid introduction of such services is therefore reliant upon a regulatory environment which is not intrusive and minimises the burden on both user and provider.

This report provides information on Ka band satellite services, including the associated demand, with aim to help the development of such environment. The existing regulatory regime for Ka band satellite services is examined and potential improvements that will allow the rapid introduction of envisaged services, particularly a regime of exemption from individual licensing for consumer and SOHO terminals are identified for consideration by Administrations.

A high level of implementation of ECC Decisions allows to minimise the regulatory burden on Ka band satellite systems and to ensure the development of such satellite networks, including in particular large-scale deployments of terminals, e.g. for broadband services. The asymmetrical situation between spectrum identified for use of uncoordinated earth stations in the Earth-to-space and space-to-Earth directions can cause difficulties and is proposed to be addressed. A regime of exemption from individual licensing for earth stations operating in the band 29.5 - 30 GHz paired with 19.7 - 20.2 GHz, along with the available bands for uncoordinatedearth stations in the 27.5 - 29.5 GHz range paired with 17.3 - 17.7 GHz, is beneficial to the development of satellite systems in Ka band. Finally, possibilities to accommodate mobile applications in Ka band are identified.In order to maintain an efficient use of spectrum in the considered bands, the studies proposed in this report should take into account the spectrum requirements as well as adequate protection of existing services.

[1] For the purpose of this Report, the term Ka band refers to the frequency bands 17.3-20.2 GHz (space to Earth) and 27.5-30 GHz (Earth to space)
[2] For the purpose of this report the term Ku band refers to the frequency bands 10.7-11.7 GHz and 12.5-12.75 GHz (space to Earth) and 12.75-13.25 GHz, 13.75-14.5 GHz (Earth to space)

Table of contents

LIST OF ABBREVIATIONS

Abbreviation	Explanation
CEPT	European Conference of Postal and Telecommunications Administrations
DRS	Data Relay System
DRSS	Data Relay Satellite System
DTH	Direct-to-home
ECA	European Common Allocations Table
e.i.r.p.	Equivalent Isotropically Radiated Power
EMC	Electromagnetic Compatibility
ECC	Electronic Communications Committee
ECO	European Communications Office
E-to-s	Earth-to-space
ETSI	European Telecommunications Standards Institute
FCC	Federal Communications Commission
FSS	Fixed-Satellite Service
GSO	Geostationary Orbit
HDFSS	High Density applications in the Fixed-Satellite Service
HEST	High e.i.r.p. Satellite Terminals
IOL	Inter-satellite Optical Link
ISP	Internet Service Provider
ITU	International Telecommunications Union
ITU-R	ITU Radiocommunication Sector
LEO	Low Earth Orbit
LEST	Low e.i.r.p. Satellite Terminals
MBA	Multiple Beam Antenna
NGA	Next Generation Access (networks)
NRA	National regulatory authority
R&TTE	Radio and Telecommunications Terminal Equipment
RF	Radio Frequency
s-to-E	Space-to-Earth
SMATV	Satellite Master Antenna Television
SOHO	Small Office Home Office
TT&C	Telemetry, Tracking and Control
UET	User Earth Terminal
UST	User Space Terminal
VSAT	Very Small Aperture Terminal
WLL	Wireless Local Loop

The use of the frequency bands 27.5-30.0 GHz and 17.3-20.2 GHz by satellite networks

1 INTRODUCTION

Satellite communications systems enable telecommunication services over wide geographical areas, connecting large numbers of users over large distances, including sparsely populated areas. The technology is mature and offers equipment at low cost, leading to satellites being an important part of the telecommunications infrastructure. Satellite services currently include very small aperture terminal (VSAT) networks, internet services, point-to-point links, satellite news gathering, TV and data broadcasting to satellite master antenna television (SMATV) and direct-to-home (DTH) receivers, as well as feeder links for the mobile satellite service. It also includes governmental uses, international commitments for civil aviation and weather, water, climate and environmental alerts, as well as supporting critical infrastructure.

Broadband communications is considered crucial to European competitiveness. Broadband is a key element of the developments that are taking place in the electronic communications markets. Consumers are benefiting from lower prices and higher speeds and a variety of broadband offers due to increasing competition in this market. The satellite market is a commercial one characterised by an intense competition between operators and technologies. In the European Union, electronic communications infrastructures and services are subject to the new regulatory framework, which is based on a technologically neutral approach.

The EU has set itself the objective of providing a favourable environment for private investment and for the creation of new jobs, to boost productivity, to modernise public services and to give everyone the opportunity to participate in the global information society. To achieve this objective, widespread availability and usage of broadband throughout the European Union needs to be established.

In reality, a large number of European households living in remote areas do not have a realistic perspective of achieving access to high speed internet for many years. This constitutes a serious obstacle to making the benefits of the information society available to all citizens and firms in the European Union. The prospects for many of the less developed partners of the EU and bridging the digital divide at a global level to ensure that all parts of the world can reap the benefits from the information society are also a concern. Satellite technologies may constitute appropriate solutions, especially for rural, peripheral and island regions.

There are some differences between satellite systems operating in the Ka band from satellite systems established in the past. With their high power and broad coverage, Ku band FSS satellites are highly optimised for video distribution and professional data networks, and are the core component of most FSS satellite systems. In CEPT, Ku band FSS systems are dominant. There has also been a large increase in the use of traditional FSS frequencies, particularly in Ku band, for mobile applications such as provision of broadband telecommunications services to aircraft in flight and ships at sea. It is reasonable to assume that this trend will continue in the Ka band. As the demand for satellite capacity has steadily increased, traditional FSS satellite technology using Ku band frequencies becomes limiting due to a global congestion of available orbital locations. Indeed, Ku band congestion over CEPT does not allow any new type of broadband geostationary systems to be deployed, due to existing systems every three degrees or less.

Because they are built to cover a very large geographical area, traditional FSS satellites display limitations to support the flexible distribution of bandwidth needed for broadband applications. Technology developments such as new multiple-beam satellite antennas (MBA) have become a key component in modern broadband satellite communication systems because they significantly increase frequency reuse and maximize bandwidth capacity. To use the MBA technology even more efficiently, broadband satellites need to use higher frequencies and are now using the Ka band frequencies associated with multiple pencil-like spot beams. Also at ground level, antenna technology has advanced in number of significant ways, e.g. in size (smaller) and in price (cheaper).

Consequently, satellite networks have started to expand into Ka band in the past few years. Today, new Ka band systems are crossing a new frontier, providing specifically designed infrastructure for interactive consumer services. These systems are now mature for mass market applications, including small and portable terminals. Not only does high-capacity Ka band broadband satellite enable the development and provision of broadband services for enterprise, in-flight, maritime and high-speed rail markets, but thanks to progress in terms of efficiency and competitiveness, Ka band broadband satellites have also a substantial impact in closing the digital divide. Indeed, Ka band is seen as a breakthrough satellite communications technology for delivering cost-effective, two-way broadband services. The two-way capability means customers do not need a traditional phone or cable line, or the expense of a traditional dial-up ISP (Internet service provider) to receive high-speed internet access. This enables dramatic improvements in access to two-way, high-speed internet services for consumers and businesses in rural and remote areas.

It is expected that more than 15 million homes in CEPT will still be beyond the range of terrestrial broadband networks in 2010 and several European administrations have already chosen high-capacity Ka band broadband satellite solutions to overcome the digital divide. As Ka band satellites aim to significantly expand capacity for consumer broadband services and mobile applications across CEPT, while providing new opportunities for local and regional new rich media services, improvements to the current regulatory framework to adequately provide for this new situation would be useful. Such improvements could allow, amongst others, a more effective development through economy of scale.

Providing a clear framework for satellite communications, broadband and especially NGA networks will allow such networks to be deployed more rapidly and more widely, thus avoiding the creation of a new digital divide. Millions of European citizens and companies will then benefit from enhanced access to telecommunication infrastructures.

This report provides administrations with an overview of current and planned satellite applications in the Ka band and identifies areas that require further studies to facilitate such applications. The report is meant as a guide to administrations regarding further work that might be needed in the ECC and identifies possible changes to ECC Decisions or other actions that could promote the speedy adoption of broadband satellite services in the Ka band.

It is to be noted that the bands 20.2-21.2 GHz and 30-31 GHz are harmonised military bands in CEPT and are therefore not addressed in this report. EU2 (“Civil-military sharing”) and EU27 (“A frequency band that is in general military use in CEPT and identified for major military utilisation in the ECA. Such a frequency band forms a basis for military use and planning. These bands can be shared between civil and military users according to national requirements and legislation”) apply.

2 ECC DECISIONS IN FORCE WITHIN THE BANDS 27.5-30 GHz AND 17.3-20.2 GHz

The current CEPT regulations applicable to the FSS Ka band consist of the following ECC decisions:

- ECC/DEC/(05)01: ECC Decision of 18 March 2005 on the use of the band 27.5-29.5 GHz by the Fixed Service and uncoordinated Earth stations of the Fixed-Satellite Service (Earth-to-space)
- ECC/DEC/(05)08: ECC Decision of 24 June 2005 on the availability of frequency bands for high density applications in the Fixed-Satellite Service (space-to-Earth and Earth-to-space)
- ECC/DEC/(06)02: ECC Decision of 24 March 2006 on Exemption from Individual Licensing of low EIRP satellite terminals (LEST) operating within the frequency bands 10.70-12.75 GHz or 19.70-20.20 GHz Space-to-Earth and 14.00-14.25 GHz or 29.50-30.00 GHz Earth-to-Space
- ECC/DEC/(06)03: ECC Decision of 24 March 2006 on Exemption from Individual Licensing of high EIRP satellite terminals (HEST) operating within the frequency bands 10.70-12.75 GHz or 19.70-20.20 GHz space-to-Earth and 14.00-14.25 GHz or 29.50-30.00 GHz Earth-to-space
- ERC/DEC/(00)07: ERC Decision of 19 October 2000 on the shared use of the band 17.7-19.7 GHz by the fixed service and Earth stations of the fixed-satellite service (space-to-Earth)

	Ka band	Ku band
Uplink	27.5 to 30.0 GHz	12.75 to 13.25 and 13.75 to 14.5 GHz
Downlink	17.3 to 20.2 GHz	10.7 to 11.7 GHz and 12.5 to 12.75 GHz

Table 1: Ku and Ka bands FSS allocations in CEPT

	Ka band	Ku band
Uplink	29.5 GHz to 30.0 GHz	14.0 to 14.25 GHz
Downlink	19.7 GHz to 20.2 GHz	12.5-12.75 GHz

Table 2: Ku and Ka band FSS allocations in CEPT in which a regime of exemption from individual licensing for satellite terminals is advocated by ECC Decisions

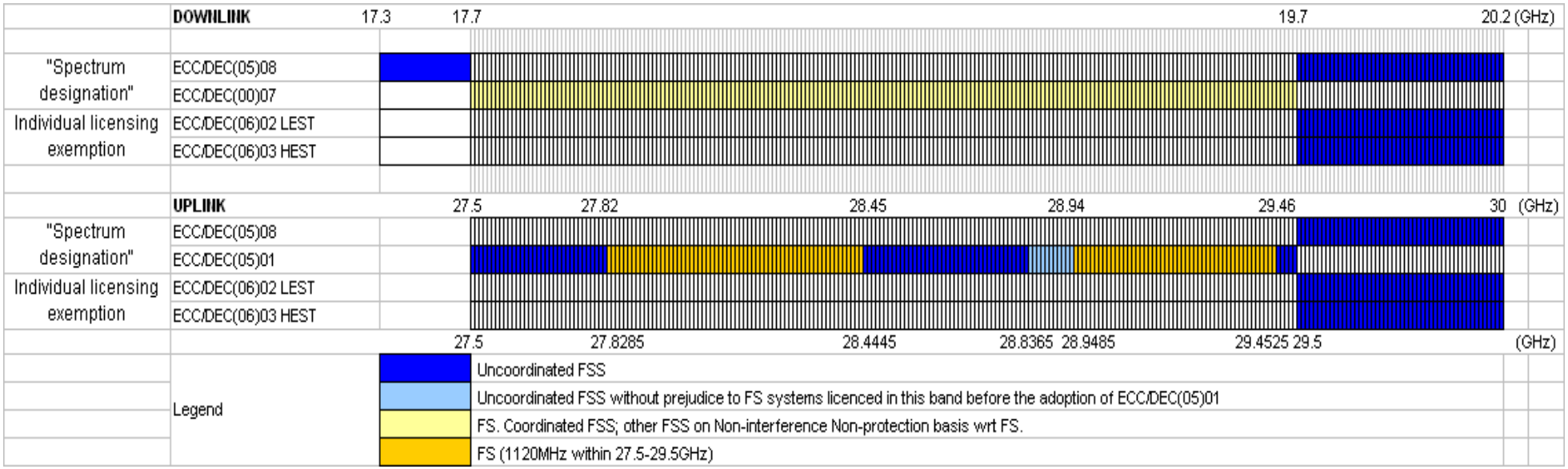

Figure 1: Overview of current ECC Decisions in force in the bands 27.5-30 GHz and 17.3-20.2 GHz

3 KA BAND SATELLITE SERVICES

3.1 The need for Ka band satellite services

The growing satellite communications market within CEPT makes it more and more difficult to assign frequency resources in the commonly used frequency bands at 4-6 GHz and 11-14 GHz. Thus, frequency bands above 17 GHz are of increasing interest for future satellite communication links.

The value of broadband access as a socio economic benefit is no longer disputed. As illustrated in the table below, European member states place an increasingly high value on the ability of all their citizens to participate in the knowledge economy through better communications links. Importantly, equality of access is a key criteria and political motivator for broadband services.

EC Member states	Governmental plan title
Italy	"Piano e-Government 2012", December 2008
France	« France numérique 2012 », October 2008
Germany	Breitbandstrategie der Bundesregierung, February 2009
Greece	Greek Digital Strategy 2006-2013, July 2005
Spain	Avanza Infraestructuras"(2008-2011)"
United Kingdom	Digital Britain, February 2009

Table 3

In these government plans, some consensus is emerging on the need to generalize access to fixed broadband internet, possibly supported by public/private finance initiatives.

In addition, there is a clear understanding that there is no single technology which can provide full equality of access. Instead, several technologies must be used to serve different user communities at best value for money.

Ka band satellite broadband applications present a number of advantages, and indeed, some drawbacks, in comparison with other broadband solutions, their suitability depending on the environment considered. For example, in rural and other isolated areas, where fibre links could be prohibitively expensive, satellite Ka band can be used to overcome first-mile connectivity gaps.

In some European countries, wireless local loop (WLL) has not yet reached the expected deployment although similar technologies have been partly deployed. In addition, There is an evident urban-rural gap in coverage, since broadband is still unavailable to 7% of Europeans and to 23% of the rural population. Therefore, several countries have chosen high-capacity Ka band broadband satellite solutions to overcome the digital divide.

There is more spectrum allocated at Ka band: the current regime of exemption from individual licensing for satellite terminals at Ku is limited to 250 MHz on the uplink, i.e. from 14.0 to 14.25 GHz, while at Ka band it is double, i.e. 500 MHz on both uplink (29.5–30 GHz) and downlink (19.7–20.2 GHz). This portion of the Ka band has a better interference environment and its use is in practice limited to small terminals. The equivalent in Ku band is more widely used and interference to adjacent satellites could be the limiting factor in terms of terminal size for the return link (user terminal to gateway link). Furthermore, Ku band congestion over CEPT does not allow any new broadband GSO systems to be deployed, due to existing systems at every three degrees or less on the geostationary arc visible from CEPT.

Several European countries have highlighted their intention to foster the deployment of broadband services. Ka band satellites currently under development and specifically dedicated to broadband access will soon offer consumers a broadband solution, meeting evolving high data-rate applications by offering performance levels comparable to ADSL 2 or cable connections, with download data rates available to the user up to 10 Mbps.

It is also noted that based on the number of Ka band FSS band ITU satellite network filings made to date by Administrations to cover CEPT (more than 200 at the coordination stage and about 50 at the notification stage), there is considerable interest in use of Ka band FSS allocations in CEPT for future Ka band FSS systems.

3.1.1 Technical aspects

Ka band satellite broadband service is a new approach to satellite communications. Improvements in Ka band technology include amongst others:

- Systems employ narrow "spot beams" rather than a single coverage area over a region. A far more efficient use of the available bandwidth resulting in a higher throughput and a much lower transmission cost per Mbytes. In CEPT, contracted and planned Ka band satellites will use multiple tens and up to several hundreds of spot beams for broadband access systems. Spot beam apertures of less than 0.3° and advanced beam pointing error correction techniques are foreseen. This new kind of architecture marks a material step forward in multi-beam satellites that are already demonstrating their efficiency in the market for broadband Internet access, IPTV and other multimedia applications, particularly but not limited to users located in rural areas.
- Higher frequency means that, for a given satellite antenna aperture, the spot beam is smaller, allowing a coverage composed of smaller cells. Compared to lower frequency bands, smaller cells in Ka band imply a better individual coverage and a higher gain:.
    - On the forward link (gateway-to-terminals) this ensures that the satellite power is used efficiently with high equivalent isotropically radiated power (e.i.r.p.) on the target area
    - On the return link (terminals-to-gateway), this improves the G/T (gain-over-temperature) of the satellite receive system ensuring that for a given bit rate smaller resources (compared to lower frequency bands) are required at the terminals in terms of radio frequency (RF) power required from the high power amplifier (HPA) and antenna aperture. All this contributes towards smaller user terminals.
- High satellite e.i.r.p. and G/T will allow to accommodate small-size user antennas (e.g. down to about 40 cm diameter dish) compatible with requirements on transportability. Systems do not require very large dishes nor high transmit power to produce high speed internet in either direction (downloads and uploads are both very fast), resulting in a lower equipment cost to consumers. Moreover, widespread standards have made it possible to drive down the cost of user equipment. However, generally the smaller the satellite terminals the larger the orbital separation that would be required between Ka band geostationary satellite systems for co-frequency co-coverage simultaneous operations. The dish size required by the terminals will therefore be always a compromise depending on system requirements.
- Improved spectrum efficiency:
    - In particular due to multispot frequency re-use. For a given service area, more cells can be included when the cells are smaller. This supports a higher order of frequency reuse. Typically four cell schemes are used to ensure a good C/I (carrier to interference ratio).

Ka band offers opportunities to design payload with higher system capacity as compared to Ku band.

- at the technical level, high system capacity can permit:
    - to increase the data rates to and from the terminals
    - to increase the quality of service
    - to increase the number of terminals within the system
    - to provide a combination of the above

Using a traditional Ku band satellite at a premium orbital slot dedicated to DTH services for broadband access would increase the subscriber fee by a factor of 5 to 10 and reduce capacity for DTH channels.

- at the commercial level, these factors combine to help the Ka band system reduce the cost of service provision, making broadband access an affordable service for the consumer market

- Systems use technology that drastically lowers the impact of latency (the "lag" created by data travelling to the satellite and back). Among other, mesh capability will be introduced to halve the latency for terminal to terminal connections.
- Propagation at Ka band is a disadvantage compared to lower frequency bands, but mitigation techniques are available to both user and satellite. For example, site diversity can be implemented for gateways.

Concerning coordination issues, the following issues are particularly pertinent:

- Ku band congestion over CEPT does not allow any new kind of broadband GSO systems to be deployed, due to existing systems every three degrees or less.
- In ITU-R Region 1, no more than 750 MHz in each direction are allocated to unplanned FSS in Ku band, while at Ka band at least 2500 MHz in each direction are allocated to unplanned FSS.
- Ka band generally allows coordination of satellite networks employing 66cm earth station dishes with typically two degrees orbital spacing. The use of even smaller earth stations would also be possible, with adequate coordination schemes, e.g. larger orbital spacing or other arrangements.
- Ka band frequencies enable improved spectrum efficiency (e.g. multiple beam antennas).

3.1.2 Applications

Ka band satellite broadband services over CEPT currently enable diverse applications such as:

- Internet: Provisioning of broadband access to small and medium enterprise, households as well as individuals in low density populated areas (more than 50% of European territory).
- Information & Entertainment: Broadcasting high quality of service (QOS) TV in high definition or even 3D format as well as emerging interactive broadcast services. Provisioning of triple play services (Internet broadband access, VoIP, IPTV/VoD).
- Broadband service to mobile platforms: Services are currently being provided to mobile platforms such as aircraft, ships, cars and trains using FSS transponders in the Ku band. Several service providers have plans to offer similar services using Ka band FSS allocations.
- Business continuity: Provisioning of high QoS as well as reliable and dependable private communication networks for real time exchange of critical information between geographically distributed entities;
- Disaster management: Surveillance of critical or dangerous assets as well environmental monitoring with data collection from sensors deployed in remote areas. Coordination of first responder teams deployed with broadband transportable solutions as well as for the recovery of Internet and cellular access;
- National and international security domain: civilian satcom systems are also key elements for defence missions especially when forces are deployed overseas.
- Feeder links for satellite data relay systems. A general description of this application is provided in Annex 1.

The intrinsic characteristics of satellite communications associated with Ka band satellite broadband services enable administrations or NRAs to meet universal coverage obligations, particularly in low density population areas (e.g. rural areas), and thereby to remedy to the digital divide in accordance with ITU objectives, WSIS objectives, etc..

The next decade will see significant progress, obtained mainly through emerging satellite antenna and payload architecture with the generation of a higher number of very small beams, permitting enhanced service capabilities, increased overall performance and higher flexibility.

Satellite broadband services with advanced Ka band multi-beam antenna and payload technologies will be able to deliver up to 100 Mbps peak data rates on the downlink and up to 20 Mbps peak data rates on the uplink (noting actual and average data rates to simultaneous active terminals would be much lower as the beam capacity is shared among them). Hence, satellite broadband can be qualified as a complementary Next Generation Access technology.

3.2 Present market description (2009-2010)

In its report "Broadband satellite in Europe & North Africa, Residential market outlook" (released March 2009), IDATE [3]considers the best strategic positioning for satellite over Europe and North Africa in the broadband market after having first analyzed and then defined the potential target markets for satellite broadband.

IDATE considers that the potential market for satellite is composed of households that were not covered by broadband networks at the end of 2007, considering broadband as a connection with a speed of 128 kbps minimum. Therefore, IDATE only considers the un-served market.

After an analysis of different drivers of the market, IDATE has segmented the European region according to a set of criteria including socio-economic criteria, deployment of terrestrial broadband solutions and criteria linked to the development of satellite TV services. They have identified three target segments in Europe for satellite broadband that can be seen in the following map:

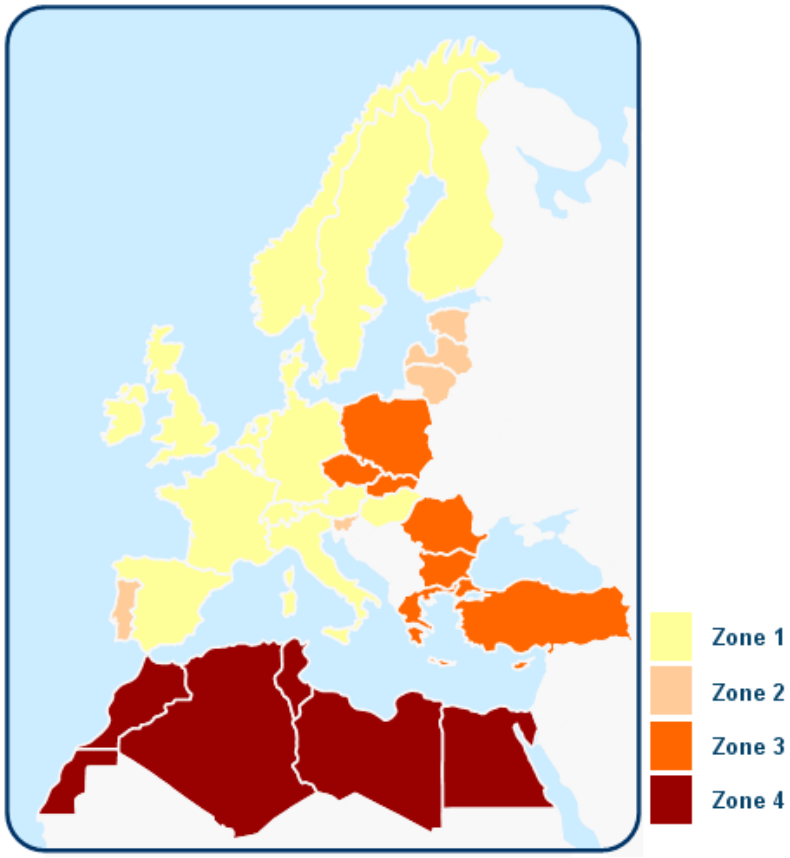

Figure 2: Broadband satellite in Europe & North Africa, Residential market outlook
(Source: IDATE, March 2009)

IDATE estimates that potential market in Europe concerns 12.4 million households that are distributed in the following way:

- Western Europe (zone 1): 5.2 million households
- Baltic countries, Portugal and Slovenia (zone 2): 0.6 million households
- Eastern Europe (except Baltics and Slovenia) and Greece (zone 3): 6.6 million households
- The fourth zone is North Africa, with 18 million of unserved households

[3] IDATE Consulting & Research is a market analysis and consulting firm in Europe. Their mission is to provide assistance to their clients in the telecommunications, Internet and media industries in terms of strategic decision-making. Their orientation over market studies is to first analyze the impact of market growth, changes in regulatory issues, evolution of technologies and then give their recommendations in terms of strategic decisions.

Note:

- These figures do not include Switzerland, Bulgaria, Romania and Turkey due to unavailable data
- They are based on the consideration of DSL coverage in the different countries
- They are not taking the previous criteria for the segmentation like PC penetration or purchasing power into account.

Ka band satellite broadband services are already offered in North America and CEPT. The operational systems have demonstrated the maturity of the technology, the viability and appropriateness of services provided to users. Continuity and development of these services is needed, through the development of more ambitious and innovative satellite networks. The success of these services has justified procurements of dedicated satellites over North America and CEPT, see section 3.1 (and description in Annex 3).

3.3 Envisaged market

The new-generation satellite and associated on-ground infrastructure will expand the scope of consumers served by a single satellite from several thousand, to over one million, with broadband solutions meeting evolving high bit-rate applications. New dedicated broadband satellite services will be able to offer performance levels comparable to ADSL 2 and cable connections, with speeds to the user of up to 10 Mbps. This section and the following present market and subscriber forecasts for satellite broadband, market ramp-up and estimations of spectrum requirements. It provides an updated and harmonised assessment of the Ka Band Broadband satellite market.

3.3.1 Market, subscribers and market ramp-up forecasts

Market, subscriber and market ramp-up forecasts from three different studies are provided in Annex 2. These studies are based on different assumptions and methodologies, therefore the results are accordingly different. However, there is a clear trend common to these three studies that the demand for Ka band satellite services in CEPT will be significant.

3.3.2 Spectrum requirements forecasts

There are several possibilities to estimate future spectrum requirements for satellite broadband. However, it appears that independently of the method and assumptions used, there is a clear trend that such demand will increase.
The following forecasts are based on an assessment of the addressable market worldwide, essentially consisting of users in rural regions without a DSL connection.

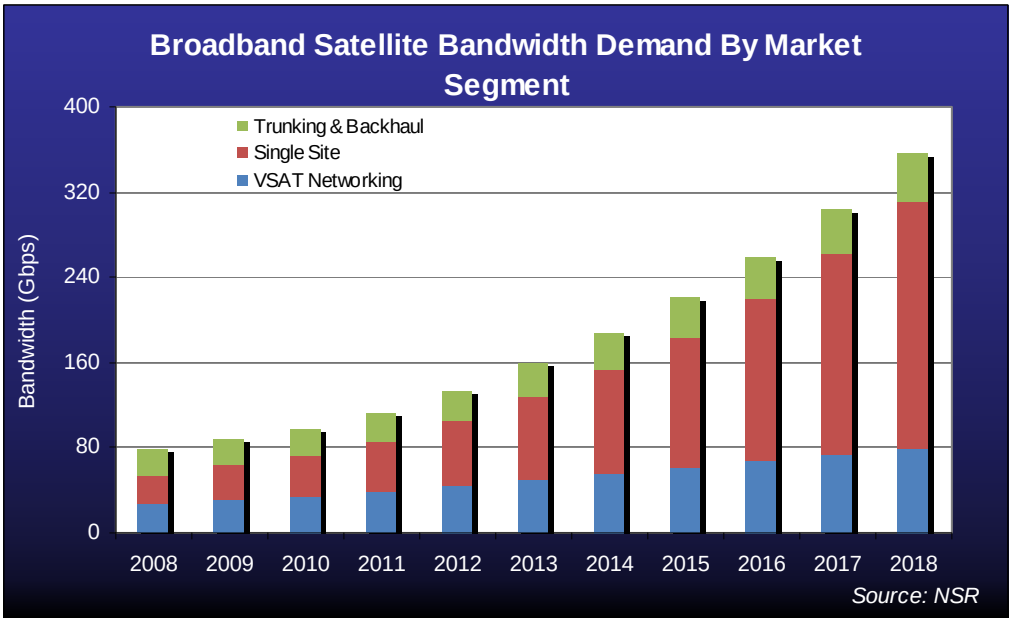

Figure 3: Worldwide Broadband satellite bandwidth demand by market segment

From 2008 onwards, it is assumed a decrease of subscribers on systems using “regular payloads” (i.e. Ku band) versus multispot beam payloads. Clearly only Ka band multispot beams are assumed by the end of the forecast period.

Forecasts show a need of 232 Gbps[4] in 2018, which can be extrapolated to about 120 GHz of Ka band bandwidth. This high growth indicates that satellite industry would require much more capacity after 2018. One European satellite operator believes that other applications will likely make use of Ka band in the long term, such as backhauling and VSAT applications, hence requiring even more Ka band capacity. During the forecast period, supply and demand for Ka band is expected to grow and decrease for Ku band capacity. This trend signifies a shift of leased transponder capacity from Ku band to Ka band for applications requiring smaller outdoor units, with higher bandwidth consumption and more efficient use of the spectrum.

3.3.3 Comparison with Ku band systems

Today, Ku band satellite systems are reaching saturation in the geostationary arc over CEPT, as a consequence, any new development of Ku band satellite systems can only occur on a like-for-like basis. On the contrary, Ka band still allows development of new broadband satellite systems. Furthermore, new-generation Ka band satellite systems are far more efficient in term of broadband access delivery thanks to innovative design base on the largest multi-beam architecture. Indeed, Ka band is widely accepted as a breakthrough satellite communications technology for delivering cost-effective, two-way broadband services. All this makes Ka band satellites a broadband access solution of prime importance.

3.3.4 Large expansion towards more mobility

Because of administrations duty to meet universal coverage, Ka band satellite broadband services offer economically viable mass-market solutions that can contribute to bridging the digital divide, particularly in low density population area. The development of mobile terminals in Ka band would also foster its market success by addressing directly smaller devices in the future, such as laptop for instance. Because the current regulation, including standards, have been tailored for lower frequency bands, off-axis emissions masks in particular make difficult the use of smaller antenna for emission (less than 66 cm). For smaller terminals use, it is likely that some modifications to the current framework would be required.

3.3.5 Improvements to the regulatory framework

The present national regulations have been developed in a given context, but with the emergence of new types of consumer oriented services, it is desirable that these regulations develop to ensure the legal certainty needed by new Ka band satellite broadband services. An evaluation of the current regulatory tools is made below.

4 PRESENT OPERATIONAL AND REGULATORY SITUATION

4.1 Present satellite systems in operation

As mentioned in section 3.2, different types of broadband satellite systems provide services today. The first existing ones were mainly focused on professional customers, whereas the new ones broaden their outlook by targeting also the mass market. A description of operational and planned systems is provided in Annex 3.

4.2 Overview of present ITU regulations

See Annexes 4 and 5.

4.3 Analysis of present CEPT regulations

4.3.1 Analysis of ECC Decisions in force within the bands 27.5-30 GHz and 17.3-20.2 GHz

This section analyses the impact of implementation or non implementation of the existing relevant ECC or ERC Decisions on satellite operations. It also suggests some modifications to the existing framework to strengthen the FSS regulatory status in Ka band. The overall situation is summarised in Annex 5.

In addition to the analysis below, it is important to note that there is a general agreement that when the efficient use of the frequency spectrum is not at risk and as long as harmful interference is unlikely, the installation and use of radio equipment might be exempted from individual licensing. Within the EEA, Directive 2009/140/EC (the Authorisation Directive)

[4] This capacity has been forecast for a single site broadband application

introduces the principle that individual licensing is only justified for reasons related to the effective/efficient use of the spectrum and the avoidance of harmful interference.

- **ECC/DEC/(05)01 ("Spectrum Designation Decision in the band 27.5-29.5 GHz")**

By a Decision taken on 18 March 2005 (ECC/DEC/(05)01), the CEPT administrations, in conjuntion with industry, decided to "segment" the frequency band 27.5-29.5 GHz between FS and FSS (uncoordinated FSS earth stations), taking into account the existing channel arrangement for the FS as detailed in CEPT Recommendation T/R 13-02, while the whole band remains open to coordinated FSS earth stations (as underlined in *Considering r*) using established co-ordination procedures.

- the frequency bands 27.5-27.8285 GHz, 28.4445-28.8365 GHz and 29.4525-29.5 GHz are designated for the use of uncoordinated FSS earth stations ("transportable and uncoordinated FSS terminals"). This represents 880 MHz for uncoordinated FSS earth stations: one block of 504 MHz, one block of 328.5 MHz and one block of 47.5 MHz
- the frequency bands 27.8285-28.4445 GHz and 28.9485-29.4525 GHz are designated for the use of FS systems. This represents 1008 MHz for FS stations: two paired bands of 504 MHz each.
- the frequency band 28.8365-28.9485 GHz are designated for the use of uncoordinated FSS earth stations without prejudice to the FS systems licensed in this band in some countries before the date of adoption of this Decision. This represents an additional 112 MHz within which no new FS stations can be deployed except in countries which make use of Decides 2) and 4) of ECC/DEC/(05)01.

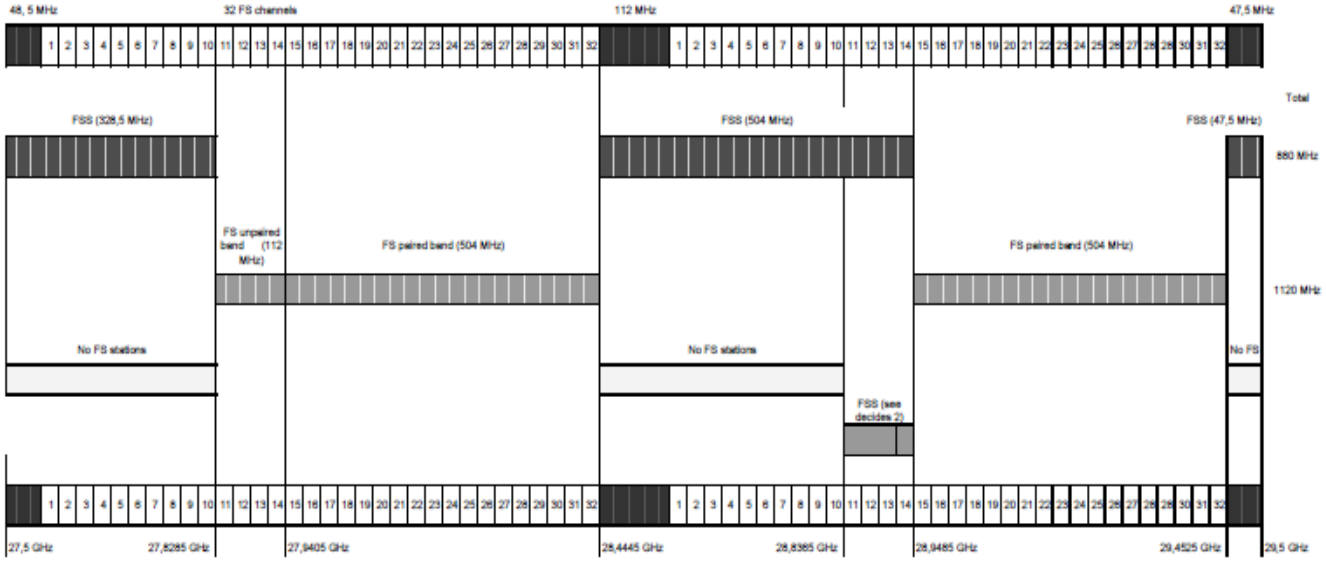

Figure 4: Band segmentation in the 28 GHz band

This Decision identifies Earth-to-space exclusive spectrum for the use of uncoordinated FSS earth stations. This spectrum would add to the exclusive FSS band 29.5-30 GHz identified in ECC/DEC/(05)08 for HDFSS deployment and therefore the use of uncoordinatedearth stations.

This appears to be a first-step incentive to deploy higher capacity broadband satellite systems throughout CEPT. Indeed, thanks to an increased bandwidth available for end-user satellite terminals, satellite operators will be able to target a larger part of the European households still beyond the range of terrestrial networks or to offer them better throughputs (fast broadband).

Proposals for new GSO and NGSO systems in the FSS indicate that large numbers of user terminals are intended to be deployed on a basis for direct customer access in this frequency band. In particular, some European administrations are promoting GSO FSS systems in this band in the context of removing the "digital divide" taking into account that, below 70 GHz, the 27.5-29.5 GHz frequency range is currently the most suitable for transmission by low-cost terminals in such systems and has the potential to make them economically and technically viable, complementing the satellite exclusive 29.5-30.0 GHz frequency range.

However, so far, this Decision has been declared as having been implemented by 17 CEPT administrations (2 *Not Implemented*, 5 *Implementation Under Study*, 23 *No Information, 1 not listed* – See Table 3). Given the transnational nature

of satellite services, these satellite systems cannot be deployed in CEPT unless a major part of the CEPT administrations implement ECC/DEC/(05)01.

Countries	ECC/DEC/(05)01	Comments
Albania	NI	
Andorra	NI	
Austria	Yes	Implemented with the Frequency Utilisation Ordinance. Note: the frequency band 28.8365-28.9485 GHz is licensed to FS systems in accordance with Decides 2
Azerbaijan	NI	
Belarus	NI	
Belgium	Yes	
Bosnia and Herzegovina	NI	
Bulgaria	Yes	Technical requirements for the operation of the electronic communications networks and relevant equipment in fixed-satellite and mobile-satellite services
Croatia	Yes	
Cyprus	US	
Czech Republic	NI	
Denmark	No	Will not be implemented, as the Decision would reduce the amount of spectrum available for the introduction of Fixed Service systems in Denmark
Estonia	Yes	Implemented through reference in "The Estonian radio frequency allocation plan"
Finland	Yes	Implemented by regulation FICORA 4 on radio frequency regulation, see http://www.ficora.fi/en/index/palvelut/palvelutaiheittain/radiotaajuudet/radiotaajuusmaarays4.html
France	Yes	This Decision is implemented in the French table of frequency allocation
Georgia	Not listed	
Germany	Yes	
Greece	NI	
Hungary	Yes	National Table of Frequency Allocations, which was published by Government Decree No.346/2004 (XII.22.) Korm., national footnotes H194B, H206 of the National Table of Frequency Allocations, and Decree No. 35/2004 (XII.28.) IHM on the establishment of the rules relating to the use of frequency bands ; Note: in the frequency band 28.8365-28.9485 GHz no FS systems are licensed
Iceland	Yes	Implementation through reference in the National Table of Frequency Allocation
Ireland	NI	
Italy	NI	
Latvia	Yes	
Liechtenstein	Yes	
Lithuania	US	
Luxembourg	Yes	Through reference in Luxembourg's national table of frequency allocations, version 2008
Macedonia	Yes	
Malta	US	
Moldova	NI	
Monaco	NI	
Montenegro	NI	
Netherlands	Yes	
Norway	US	
Poland	NI	
Portugal	US	
Romania	NI	
Russian Federation	NI	
San Marino	NI	
Serbia	NI	
Slovakia	NI	
Slovenia	Yes	NTFA
Spain	Yes	
Sweden	No	
Switzerland	NI	
Turkey	NI	
Ukraine	NI	
United Kingdom	NI	The bands 27.5 – 27.8185GHz, 28.4545 – 28.8265 GHz and 29.4625 -29.5 GHz can be used by both coordinated and uncoordinated earth stations. Uncoordinated stations with an EIRP below 50dBW (soon to be 55dBW) operate on a licence exempt basis
Vatican City	NI	

Table 4: Implementation of ECC/DEC/(05)01

Proposals in relation to the analysis of ECC/DEC/(05)01

- Assess the use of the FS in the band 28.8365-28.9485 GHz (112 MHz in which FS stations were "grandfathered" or those countries where relevant parts of the Decision have not been implemented), in particular in the countries referred to in Decides 2 of ECC/DEC(05)01;
- Study whether this band could be made available for the use of uncoordinated FSS earth stations without constraints. (Remark: this would bring the amount of spectrum designated to uncoordinated FSS earth stations within the band 27.5-29.5 GHz to 992 MHz, while leaving 1120 MHz for FS stations);
- Study whether a regime of exemption from individual licensing could be developed in the sub-bands identified for the use of uncoordinated FSS earth stations ("band segmentation" of ECC/DEC(05)01): 27.5-27.8285 GHz, 28.4445-28.8365 GHz and 29.4525-29.5 GHz, possibly including 28.8365-28.9485 GHz - the above mentioned 112 MHz - depending on the results of above mentioned studies), on the basis of ECC/DEC/(06)02 and ECC/DEC(06)03;

In conducting this exercise, the situation in some countries where, for example auctions have taken place, should be described and taken into account. This may constrain/limit the deployment of satellite terminals in these countries.

- **ECC/DEC/(05)08 ("Spectrum Designation Decision for HDFSS")**

Within Ka band, WRC-03 decided to identify the bands 17.3-17.7/19.7-20.2 (downlink) & 29.5-30.0 GHz (uplink) for HDFSS (5.516B).

By a Decision taken on 24 June 2005 (ECC/DEC/(05)08), the CEPT administrations decided (cf. Decides 1) that some or all of the bands 17.3-17.7 GHz (space-to-Earth), 19.7-20.2 GHz (space-to-Earth) and 29.5-30 GHz (Earth-to-space) shall be made available by administrations for HDFSS deployment subject to market demand, thereby addressing the above mentioned WRC decision to some extent. Decides 3 and 4 are in line with the ITU Radio Regulations. Among the bands covered by this Decision and addressed in this report, the bands 17.3-17.7 GHz, 19.7-20.2 GHz and 29.50-30 GHz are not allocated to any terrestrial service on a primary basis.

Once made available, it is decided that the CEPT administrations shall authorise the deployment of uncoordinated FSS earth stations in these bands.

So far, this Decision has been declared as having been implemented by 16 CEPT administrations (2 *Not Implemented* , 4 *Implementation Under Study*, 26 *No Information* – see Table 4).

Countries	ECC/DEC/(05)08	Comments
Albania	NI	
Andorra	NI	
Austria	Yes	Implemented with the Frequency Utilisation Ordinance
Azerbaijan	NI	
Belarus	NI	
Belgium	NI	
Bosnia and Herzegovina	NI	
Bulgaria	Yes	Implemented through reference in the National Frequency Allocation Table and Technical requirements for the operation of the electronic communications networks and relevant equipment in fixed-satelite and mobile-satellite services
Croatia	Yes	
Cyprus	US	
Czech Republic	NI	
Denmark	Yes	Implementation through reference in the national table of frequency allocations
Estonia	Yes	Implemented through reference in "The Estonian radio frequency allocation plan"
Finland	Yes	Implemented by regulation FICORA 4 on radio frequency regulation, see http://www.ficora.fi/en/index/palvelut/palvelutaiheittain/radiotaajuudet/radiotaajuusmaarays4.html
France	Yes	Information will be published on the ARCEP website: www.arcep.fr
Georgia	NI	
Germany	Yes	Terminals are exempted from individual licensing but the operation is allowed only under the control of a satellite newtork, which needs to be authorised by the NRA
Greece	NI	
Hungary	Yes	National footnotes H193A, H194B of the National Table of Frequency Allocations, which was published by Governement Decree No.346/2004 (XII.22.) Korm. Note: All the bands listed in Decides 1 are made available
Iceland	Yes	Implementation through reference in the national table of frequency allocation
Ireland	NI	
Italy	NI	
Latvia	No	
Liechtenstein	Yes	
Lithuania	US	
Luxembourg	Yes	Through reference in Luxembourg's national table of frequency allocations
Macedonia	NI	
Malta	US	
Moldova	NI	
Monaco	NI	
Montenegro	NI	
Netherlands	Yes	Implemented by reference in the National Frequency Table
Norway	Yes	
Poland	NI	
Portugal	US	
Romania	NI	
Russian Federation	NI	
San Marino	NI	
Serbia	NI	
Slovakia	NI	
Slovenia	Yes	NTFA
Spain	Yes	
Sweden	No	29.5-30 GHz band implemented by National Frequency Allocation Table and PTS Exemption Regulations
Switzerland	NI	
Turkey	NI	
Ukraine	NI	
United Kingdom	NI	Whilst not implemented by legislation, the band is available for unprotected, uncoordinated use in the space to earth direction (shared with BSS feeder links, (about 6 sites in SE). The band is no longer assigned o fixed links and only three or four remain
Vatican City	NI	

Table 5: Implementation of ECC/DEC/(05)08

It is actually necessary to confirm and preserve exclusive satellite access to the frequency bands 17.3-17.7 GHz (space-to-Earth), 19.7-20.2 GHz (space-to-Earth) and 29.5-30 GHz (Earth-to-space). Indeed, uncoordinated FSS earth stations need, by nature, to be deployed in exclusive frequency bands to avoid interference issues.

However, the status of these frequency bands is quite uncertain. Indeed, they are supposed to be made available for HDFSS deployment, although the concept of High Density applications in the fixed-satellite service itself is not defined by the CEPT administrations. Given the articulation of Decide 1 and Decide 5 of the Decision, it may be considered that HDFSS deployment is equivalent to uncoordinated FSS earth stations but it is open to interpretation, which offers little regulatory certainty.

Then, the CEPT administrations are free to make available "some or all" of the bands 17.3-17.7 GHz, 19.7-20.2 GHz and 29.5-30 GHz "subject to market demand". This could clearly lead to a fragmented regulatory landscape within CEPT which is not desirable given the transnational nature of satellite services.

Furthermore, if the frequency bands 19.7-20.2 GHz (space-to-Earth) and 29.5-30 GHz (Earth-to-space) are covered by specific ECC Decisions with regard to their licensing regime (See 3.2.4 and 3.2.5), no equivalent regulatory measure in or outside ECC/DEC/(05)08 specifies the licensing requirements for the band 17.3-17.7 GHz and more particularly provides for exemption from individual licensing of satellite terminals. This situation discourages actual deployment of end-user terminals in this band, while FSS is the only allocated primary service in the band 17.3-17.7 GHz in Region 1.

Proposals in relation to the analysis of ECC/DEC/(05)08

- Study whether the whole band 17.3-17.7 GHz could be made available for the use of uncoordinated FSS earth stations in the space-to-Earth direction, recognising that operation of uncoordinated FSS earth stations close to feeder link earth stations for the BSS Plans (Earth-to-space) may not be feasible. To that end, CEPT and/or ITU studies conducted in preparation for WRC-03 (on HDFSS) should be assessed and completed, if required, with a view to conclude on the sharing feasibility between feeder links for the BSS Plans (Earth-to-space) and FSS (space-to-Earth);
- Results could then be taken into account in an appropriate ECC regulation with a view to consider accommodating uncoordinated FSS earth stations in the space-to-Earth direction;
- As a result, study whether a regime of exemption from individual licensing could be developed in this band, on the basis of ECC/DEC/(06)02 and ECC/DEC/(06)03.

- **ECC/DEC/(06)02 ("LEST Individual Licensing Exemption Decision")**

By a Decision taken on 24 March 2006 (ECC/DEC/(06)02), CEPT administrations decided to exempt from individual licensing low e.i.r.p. satellite terminals (LEST) operating within the bands 19.7-20.2 GHz (space-to-Earth) and 29.5-30 GHz (Earth-to-space) and using an e.i.r.p. not exceeding 34 dBW. LESTs operate under the control of the geostationary satellite systems, providing digital communications.

The aim of this Decision is to exempt LESTs from individual licensing because they fulfil the criteria for exemption listed in ERC/REC 01-07[5].

Considering g of this Decision underlines that intervention by the national administrations with respect to the use of radio equipment should in general not exceed the level necessary for the efficient use of the frequency spectrum.

Considering that equipements using an e.i.r.p. below 34 dBW, if they operate within exclusive FSS frequency bands, are particularly unlikely to cause undue interference to other services in CEPT, a blanket-type licensing approach (i.e. no individual licensing of terminals but a network license may be required) is therefore appropriate.

[5] CEPT administrations should implement a regime for exemption from individual licensing for the use of frequency-bands which meet the following criteria:
a) the radio equipment needed for the use of the radio frequencies fulfils the technical requirements of the CEPT Administration in question;
b) individual frequency assignment is not needed;
c) there is a high degree of certainty that the use of the frequency-band in question will not change for a long period;
d) there is no need to establish individual provisions for each user;
e) there is no need for the Administration to register individual users;
f) there is little risk of harmful interference being caused."

This approach reduces the cost and administrative burden associated with the authorisation request for and registration of each individual uncoordinated FSSearth station and in consequence encourages the deployment of broadband terminals on a large scale in CEPT.

However, so far, this Decision has been declared as having been implemented by only 19 CEPT administrations (2 *Not Implemented*, 2 *Committed to Implement*, 3 *Implementation Under Study*, 1 *withdrawn*, 21 *No Information* – See Table 5). Given the transnational nature of satellite services, the CEPT administrations, which did not do so yet, are therefore invited to implement ECC/DEC/(06)03 into their national law.

Proposals in relation to the analysis of ECC/DEC/(06)02

The implementation of this Decision is becoming a matter of urgency since it is intended, together with ECC/DEC/(06)03, to replace ERC/DEC/(00)03 on exemption from individual licensing of satellite interactive terminals (SITs) operating within the frequency bands 10.7-12.75 GHz (space-to-Earth) and 29.5-30 GHz (Earth-to-space), and ERC/DEC/(00)04 on exemption from individual licensing of satellite user terminals (SUTs) within the frequency bands 19.7-20.2 GHz (space-to-Earth) and 29.5-30 GHz (Earth-to-space).

It should be noted that some administrations consider that the basis for the regulation of free circulation and use of terminal equipment is given by the RTTE Directive and as a consequence do not need to implement the ECC/DEC/(06)02.

Countries	ECC/DEC/(06)02	Comments
Albania	NI	
Andorra	NI	
Austria	Yes	Implemented with the Frequency Utilisation Ordinance
Azerbaijan	NI	
Belarus	NI	
Belgium	Committed	
Bosnia and Herzegovina	NI	
Bulgaria	Yes	Implemented by the Regulation on performance of electronic communications for own needs by means of radio equipement using radiofrequency spectrum which is not individually assigned and Technical requirements for the operation of the electronic communications networks and relevant equipment in fixed-satellite and mobile-satellite services
Croatia	Yes	
Cyprus	US	
Czech Republic	Yes	VO-R/4/05.2009-6
Denmark	Yes	Implementation through reference in the national table of frequency allocations and executive order (at present No 1119 of 27 November 2009)
Estonia	Yes	Implemented through reference in "Conditions for use of radio frequencies and technical requirements for radio equipment exempted from frequency authorisation"
Finland	Yes	Implemented by Regulations FICORA 4 on radio frequency regulation and FICORA 15 on collective frequencies for licence-exempt radio transmitters and on their use, see http://www.ficora.fi/en/index/palvelut/palvelutaiheittain/radiotaajuudet/radiotaajuusmaarays4.html
France	No	No specific measure will be adopted on this issue . The French regulation already allow free circulation and use of terminal equipment connected to networks which are authorised in France. Information will be published on the ARCEP web site: www.arcep.fr
Georgia	NI	
Germany	Yes	Terminals are exempted from individual licensing but the operation is allowed only under the control of a satellite newtork, which needs to be authorised by the NRA. The radio application is limited to the frequency band 14.00-14.25 GHz
Greece	NI	
Hungary	Planned	
Iceland	Yes	Implementation through reference in the National Table of Frequency Allocation
Ireland	Yes	Provision has been made in the NTFA
Italy	NI	
Latvia	No	
Liechtenstein	Yes	
Lithuania	Yes	Implemented by Order No. 1V-173 of the Director of the Communications Regulatory Authority of 19 February 2008 on the amendment of Order No. 1V-27 of the Director of the Communications Regulatory Authority of 13 March 2003 on Approval of the List of Frequencies (channels), which may be used without an individual authorization
Luxembourg	Yes	Through reference in Luxembourg's national table of frequency allocations
Macedonia	NI	
Malta	US	
Moldova	NI	
Monaco	NI	
Montenegro	NI	
Netherlands	Yes	Exemption from individual licensing is implemented in the relevant executive order
Norway	Yes	
Poland	NI	
Portugal	US	
Romania	NI	
Russian Federation	NI	
San Marino	NI	
Serbia	NI	
Slovakia	NI	
Slovenia	Yes	NTFA
Spain	Yes	
Sweden	Yes	Implemented by PTS exemption regulations
Switzerland	Yes	The exemption from individual licensing requirement only applies subject to a valid operators licence for the Swiss territory which includes the use of individual customer terminals
Turkey	NI	
Ukraine	Withdrawn	
United Kingdom	NI	
Vatican City	NI	

Table 6: Implementation of ECC/DEC/(06)02

- **ECC/DEC/(06)03 ("HEST Individual Licensing Exemption Decision")**

By a Decision taken on 24 March 2006 (ECC/DEC/(06)03), the CEPT administrations decided to exempt from individual licensing high e.i.r.p. satellite terminals (HEST) operating within the bands 19.7-20.2 GHz (space-to-Earth) and 29.5-30 GHz (Earth-to-space) and using an e.i.r.p. greater than 34 dBW but not exceeding 60 dBW or a value within the range 50 - 60 dBW (depending on the maximum e.i.r.p. for licence exempted HESTs in a given country). HESTs operate under the control of the geostationary satellite systems, providing digital communications.

Considering g of this Decision underlines that intervention by the national administrations with respect to the use of radio equipment should in general not exceed the level necessary for the efficient use of the frequency spectrum.

Considering that equipements using an e.i.r.p. between 34 dBW and 60 dBW, if they operate within exclusive FSS frequency bands, are unlikely to cause undue interference to other services in CEPT, a blanket-type licensing approach (i.e. no individual licensing of terminals but a network license may be required) is therefore appropriate.

This approach reduces the cost and administrative burden associated with the authorisation request for and registration of each individual uncoordinated FSSearth station and in consequence encourages the deployment of broadband terminals on a large scale in CEPT.

However, so far, this Decision has been declared as having been implemented by only 18 CEPT administrations (2 *Not Implemented*, 1 *Committed to Implement*, 5 *Implementation Under Study*, 1 *withdrawn*, 21 *No Information* – See Table 6). Given the transnational nature of satellite services, the CEPT administrations, which did not do so yet, are therefore invited to implement ECC/DEC/(06)03 into their national law.

Proposals in relation to the analysis of ECC/DEC/(06)03

The implementation of this Decision is becoming a matter of urgency since it is intended, together with ECC/DEC/ (06)02, to replace ERC/DEC/(00)03 on exemption from individual licensing of satellite interactive terminals (SITs) operating within the frequency bands 10.7-12.75 GHz (space-to-Earth) and 29.5-30 GHz (Earth-to-space), and ERC/DEC/(00)04 on exemption from individual licensing of satellite user terminals (SUTs) within the frequency bands 19.7-20.2 GHz (space-to-Earth) and 29.5-30 GHz (Earth-to-space).

It should be noted that some administrations consider that the basis for the regulation of free circulation and use of terminal equipment is given by the RTTE Directive and as a consequence do not need to implement the ECC/DEC/(06)03.

Countries	ECC/DEC/(06)03	Comments
Albania	NI	
Andorra	NI	
Austria	Yes	
Azerbaijan	NI	
Belarus	NI	
Belgium	US	
Bosnia and Herzegovina	NI	
Bulgaria	Yes	Implemented by the Regulation on performance of electronic communications for own needs by means of radio equipement using radiofrequency spectrum which is not individually assigned, Technical requirements for the operation of the electronic communications networks and relevant equipment in fixed-satellite and mobile-satellite services and General conditions concerning the provision of electronic communications. Maximum e.i.r.p. 50 dBW. Maximum transmitter output power 2W.
Croatia	Yes	
Cyprus	US	
Czech Republic	Yes	VO-R/4/05.2009-6 ; maximum e.i.r.p. 60 dBW
Denmark	Yes	Implementation through reference in the national table of frequency allocations and executive order (at present No 1119 of 27 November 2009). Maximum e.i.r.p. 60 dBW.
Estonia	Yes	Implemented through reference in "Conditions for use of radio frequencies and technical requirements for radio equipment exempted from frequency authorisation". Maximum e.i.r.p. 60 dBW.
Finland	Yes	Implemented by Regulations FICORA 4 on radio frequency regulation and FICORA 15 on collective frequencies for licence-exempt radio transmitters and on their use, see http://www.ficora.fi/en/index/palvelut/palvelutaiheittain/radiotaajuudet/radiotaajuusmaarays4.html. The licence exemption is limited to transmitters in the band 14.00-14.25 GHz and 29.5-30 GHz with a maximum e.i.r.p. of 50 dBW.
France	No	Under study. The French regulation already allow free circulation and use of terminal equipment connected to networks which are authorised in France. Information will be published on the ARCEP web site: www.arcep.fr
Georgia	NI	
Germany	Yes	Terminals are exempted from individual licensing but the operation is allowed only under the control of a satellite newtork, which needs to be authorised by the NRA. The radio application is limited to the frequency band 14.00-14.25 GHz with a maximum e.i.r.p. 50 dBW
Greece	NI	
Hungary	Planned	
Iceland	Yes	Implementation through reference in the National Table of Frequency Allocation. Maximum e.i.r.p. 50 dBW
Ireland	Yes	Provision has been made in the NTFA
Italy	NI	
Latvia	No	
Liechtenstein	Yes	
Lithuania	Yes	Implemented by Order No. 1V-173 of the Director of the Communications Regulatory Authority of 19 February 2008 on the amendment of Order No. 1V-27 of the Director of the Communications Regulatory Authority of 13 March 2003 on Approval of the List of Frequencies (channels), which may be used without an individual authorization
Luxembourg	Yes	Through reference in Luxembourg's national table of frequency allocations
Macedonia	NI	
Malta	US	
Moldova	NI	
Monaco	NI	
Montenegro	NI	
Netherlands	Yes	Exemption from individual licensing is implemented in the relevant executive order. Maximum e.i.r.p. 50 dBW. Maximum transmitter output power 2W.
Norway	Yes	Satellite Interactive Terminals (SITs) 50 dBW e.i.r.p., Satellite User Terminals (SUTs) 50 dBW e.i.r.p., Very Small Aperture Terminals (VSATs) 80 dBW e.i.r.p.
Poland	NI	
Portugal	US	
Romania	NI	
Russian Federation	NI	
San Marino	NI	
Serbia	NI	
Slovakia	NI	
Slovenia	Yes	NTFA
Spain	Yes	
Sweden	Yes	Implemented by PTS Exemption Regulations. The maximum effect allowed is 60 dBW e.i.r.p.
Switzerland	Yes	The exemption from the individual licence requirement only applies under the condition and in the framework of a valid operators licence for the Swiss territory that includes the use of individual customer terminals. Max. transmit power limit in the frequency bands 14.00-14.25 GHz and 29.5-30 GHz is 50 dBW e.i.r.p.
Turkey	NI	
Ukraine	Withdrawn	
United Kingdom	NI	
Vatican City	NI	

Table 7: Implementation of ECC/DEC/(06)03

- **ERC/DEC/(00)07 ("Spectrum Designation Decision in the band 17.7-19.7 GHz")**

By a Decision taken on 19 October 2000 (ERC/DEC/(00)07) addressing the shared use of the band 17.7 - 19.7 GHz by the fixed and fixed-satellite service, the CEPT administrations decided to limit the FSS use in the frequency band 17.7-19.7 GHz to FSS earth stations coordinated through national frequency assignment processes and that uncoordinated FSS earth stations shall not claim protection from stations of the fixed service. Furthermore, in order to decrease the probability of interference to FSS earth stations, both the FS and uncoordinated FSS earth stations shall, where practical, implement the mitigation techniques described in Annexes.

ERC/REC 12-03 recommends channelling arrangements for digital radio-relay systems in the band 17.7-19.7 GHz.

So far, this Decision has been declared as having been implemented by 30 CEPT administrations (2 *Not Implemented*, 2 *Implementation Under Study*, 1 *partly implemented*, 13 *No Information* – See Table 7).

In practice, this Decision means that uncoordinated FSS earth stations have a secondary status compared to the fixed service in the band 17.7-19.7 GHz and, as a consequence, have very limited possibilities to be deployed on a large scale in CEPT.

Using space-to-Earth spectrum available for end-user satellite terminals in addition to the exclusive FSS frequency bands (i.e. 19.7-20.2 GHz) would enable satellite operators to target a larger part of European households still beyond the range of terrestrial broadband networks or to offer them better throughputs (fast broadband).

However, under the above-mentioned conditions, the regulatory status of FSS earth stations in the band 17.7-19.7 GHz is considered not strong enough for an actual implementation in CEPT.

Proposals in relation to the analysis of ERC/DEC/(00)07

Possible studies to be carried out:

- Taking account of the regulatory situation of the FS in this band, assess the use of the FS in this band in CEPT, including the frequency plans identified in ERC/REC 12-03, with a view to identifying the feasibility of enhanced operations of uncoordinated FSS earth stations in the band 17.7-19.7 GHz;
- In particular, study the feasibility of using gaps between the paired FS frequencies, , taking into account channelling arrangements including those described in ERC/REC 12-03;
- As a result, study whether a regime of exemption from individual licensing could be developed with in appropriate sub-bands within this band (as identified, if any, from the above studies).

Countries	ERC/DEC/(00)07	Comments
Albania	NI	
Andorra	NI	
Austria	Yes	Implemented with the national Frequency Utilisation Ordinance
Azerbaijan	NI	
Belarus	NI	
Belgium	Yes	Included in the National Frequency Allocation Plan
Bosnia and Herzegovina	NI	
Bulgaria	Yes	Implemented through references in the National Table of Frequency Allocations, Technical requirements for the operation of the electronic communications networks and relevant equipment in fixed-satellite and mobile-satellite services and Technical requirements for the operation of the electronic communications networks and relevant equipment in the fixed service
Croatia	Yes	
Cyprus	Yes	Incorporated into National Frequency Allocation Table
Czech Republic	US	In some parts of the band the recommended mitigation techniques are not yet fully employed
Denmark	Yes	implemented through reference in the national table of frequency allocations
Estonia	Yes	Implemented through reference in the Estonian Frequency Allocation Plan
Finland	Yes	Implemented by the Finnish Frequency Allocation Table in http://www.thk.fi/englanti/radio/taulu.htm
France	Yes	
Georgia	NI	
Germany	Yes	
Greece	NI	
Hungary	Yes	National footnotes H159, H194B of the National Table of Frequency Allocations, which was published by Government Decree No. 346/2004 (XII.22.) Korm. and Decree No. 35/2004 (XII.28.) IHM on the establishment of the rules relating to the use of frequency bands
Iceland	Yes	National Table of Frequency Allocation
Ireland	Yes	Provision has been made in the NTFA
Italy	Yes	Implemented through a ministerial decree, dated 5 April 2001 and published on the Italian Official Gazette No. 87 dated 13 April 2001, modifying their NTFA
Latvia	Yes	
Liechtenstein	Yes	
Lithuania	Yes	Implemented by Order No. 1V-167 of the Director of the Communications Regulatory Authority of 16 December 2003 on the Approval of the Radio Frequency Usage Plan
Luxembourg	Yes	
Macedonia	Yes	
Malta	Yes	Implemented through referency in the National Frequency Plan
Moldova	No	
Monaco	NI	
Montenegro	NI	
Netherlands	Yes	
Norway	Yes	
Poland	Yes	Included in the National Table of Frequency Allocations
Portugal	US	Due to the heavy use of the fixed service in this band, the implementation of this Decision continues under consideration
Romania	NI	
Russian Federation	Yes	
San Marino	NI	
Serbia	Yes	Implementation through reference in the national table of frequency allocations
Slovakia	Yes	Included in the National Table of the Frequency Allocations
Slovenia	Yes	
Spain	Yes	
Sweden	No	
Switzerland	Yes	Implementation by revision of the National Frequency Allocations Plan
Turkey	See Remarks	Measures partly implementing the Decision. Turkish Telecom run a satellite in this band, so this band is assigned for only Turkish Telecom
Ukraine	NI	
United Kingdom	Yes	Principles incorporated into FS and FSS planning
Vatican City	NI	

Table 8: Implementation of ERC/DEC/(00)07

- **Possibilities to accommodate mobile applications in Ka band**

ECC decisions addressing satellite communications in the Ka band apply only to the FSS. Mobile applications cover, for example, broadband connectivity to mobile platforms such as ships, aircrafts and trains. It is noted that the situation in the C- and Ku bands enables, under certain regulatory, technical and operational conditions, earth stations on board vessels (ESV) and aircraft earth stations (AES) to operate using transponders in the fixed-satellite service while protecting existing FSS, FS and other users. It is noted that the accommodation of various mobile applications was the subject of extensive consideration at CEPT, in ITU-R Study Groups and at WRCs over many years.

It was also noted that WRC-12 agenda item 1.25 deals with additional MSS allocations with focus between 4-16 GHz.

In order to facilitate introduction of mobile platforms in Ka band FSS allocations, studies should be undertaken to determine the regulatory, technical and operational conditions under which such mobile platforms can be treated as typical uncoordinated FSS earth stations.

4.3.2 Experience on ECC Decisions in force within the bands 27.5-30 GHz and 17.3-20.2 GHz

- **Current level of implementation within CEPT**

The information available on the ECO website as of March 2010 provided in previous sections is summarised in the table below.

Decision	yes	planned/ committed	under study	no	no info	Other
(05)01	17 (35%)	0	5	2	23	1
(05)08	16 (33%)	0	4	2	26	0
(06)02	19 (40%)	2	3	2	21	1
(06)03	18 (38%)	1	5	2	21	1
(00)07	30 (63%)	0	2	2	13	1

Table 9: Ka band ECC Decisions implementation situation as of March 2010

- **Current ECC Decisions and present satellite systems**

The issues identified in the section 3.3.2, i.e. the asymmetry between uplink and downlink spectrum for FSS and the limitation of the exemption of individual licensing to the bands 19.7-20.2 GHz and 29.5-30.0 GHz (500 MHz), as well as the limited level of implementation of current ECC Decisions as described above has mostly limited the deployment of uncoordinated FSS earth stations to these 500 MHz and made difficult the materialisation of more ambitious satellite broadband systems targeting small satellite terminals in the rest of Ka band. However, it should be noted that in some countries, the band 17.3-17.7 GHz is available on a virtual exclusive basis and that it is feasible to use the band 17.7-19.7 GHz on an uncoordinated basis in those geographic areas where fixed link use is limited; normally remote and rural areas.

4.3.3 Considerations on licence exemption

Licence exemption is referred to the regulatory regime for a particular application for which no individual licence is required, as is the case for instance with VSAT at 14.0-14.25 GHz Earth-to-space and 10.70- 11.70 GHz space-to-Earth with 50 dBW e.i.r.p. and 2W transmit power maximum.

- ECC Report 132 on “Collective Use of Spectrum”.

In the Report on the “Collective Use of Spectrum” commissioned by the EC and conducted by a consortium of consultancy agencies (the “CUS Report”)[6], licence-exempt regimes are characterized by the following:
No individual authorisation or co-ordination is required and no fee payable for using the spectrum. Access is regulated solely by adherence to pre-defined regulatory conditions.

[6] Final Report of the “Study on Legal, Economic & Technical Aspects of ‘Collective Use’ of Spectrum in the European Community”, published November 2006

The RSPG Opinion on aspects of a European approach to 'Collective use of spectrum' (RSPG08-244 Final) adopted the following definition of "collective use of spectrum":
Collective Use of Spectrum allows an undetermined number of independent users and/or devices to access spectrum in the same range of frequencies at the same time and in a particular geographic area under a well-defined set of conditions.

Based on the previous analysis on differentiation factors, the following definition could also be proposed:
A licence-exempt regime is a general authorisation regulatory regime under a well-defined set of conditions that does not include any provision for registration and/or notification.

It should be noted that such approach would in particular mean that "exempt from an individual authorisation" is not strictly equivalent to "licence-exempt".

- Revised ERC/REC 01-07 (Bonn 1995, Helsinki 2000, Mainz 2004) "Harmonised regime for exemption from individuals licensing for the use of radio spectrum"

In this recommendation, the CEPT recommends that administrations implement a regime for exemption from individual licensing for the use of frequency-bands which meet the following criteria:

a) the radio equipment needed for the use of the radio frequencies fulfils the technical requirements of the CEPT Administration in question;

b) individual frequency assignment is not needed;

c) there is a high degree of certainty that the use of the frequency-band in question will not change for a long period;

d) there is no need to establish individual provisions for each user;

e) there is no need for the Administration to register individual users;

f) there is little risk of harmful interference being caused

4.4 Present ETSI standards

Within the EU/EFTA, the use of such equipment shall comply with the R&TTE Directive. Conformity with the essential requirements in its Article 3(2) may be demonstrated by compliance with harmonised standard EN 301 459[7] or equivalent technical specifications. An evolution of the ETSI EN 301 459 to other parts of Ka band (identified for uncoordinated earth stations) is desirable.
The off-axis emission masks of EN 301 459 are equivalent to those of the Recommendation ITU-R S.524-9, (Recommends 4). To accommodate for smaller user earth station (e.g. laptops) the following elements may be taken into account for an evolution of the standard EN 301 459:

- Note 12 of Recommendation ITU-R S.524-9 provides for a 3 dB relaxation of the off-axis limits for earth stations with a diameter below 65 cm in the band 27.5-29 GHz.
- ITU-R has developed in 2009 a new off-axis radiation pattern in Recommendation ITU-R S.1855, *"Alternative reference earth-station radiation pattern for antennas used with satellites in the geostationary-satellite orbit for use in coordination and/or interference assessment in the frequency range from 2 to 31 GHz"*. The antenna pattern offers some improvement over that of Recommendation ITU-R S.465-5 at geostationary separations in or very near the geostationary plane. At orbital geostationary separations within the coordination arc of the applicable frequency band, the improvement in the pattern may permit closer satellite spacings or an increase in the operating margins available to links making use of such antennas in the fixed-satellite service. In addition, unlike Recommendation ITU-R S.465 which assumes rotationally symmetric antenna patterns, this draft new Recommendation (DNR) makes no such assumption and, therefore, other antenna shapes (i.e. rectangular, elliptical, etc.) are addressed.

[7] Harmonized EN for Satellite Interactive Terminals (SIT) and Satellite User Terminals (SUT) transmitting towards satellites in geostationary orbit in the 29.5 to 30.0 GHz frequency bands covering essential requirements under article 3.2 of the R&TTE Directive.

5 FUTURE SITUATION AND REGULATORY REQUIREMENTS

5.1 Scope of some known projects, future systems and implementation aspects

A description of future systems for satellite broadband access in CEPT, as well as follow-on plans for a data relay satellite system, is provided in Annex 6.

5.2 Regulatory aspects

This section analyses the regulatory needs for current and future Ka band satellite systems. First, some of the existing Decisions are particularly relevant for them and shall be fully implemented within the CEPT. Then, it appears that vital regulatory measures are missing, in particular with regard to the identification of space-to-Earth frequency bands for the use of uncoordinated FSS earth stations and the exemption of individual licensing in such bands. This needs to be addressed by CEPT administrations.

5.2.1 Regulatory requirements

1) Level of implementation of ECC Decisions

A high level of implementation of ECC Decisions by administrations concerning the Ka bands is crucial for the development of satellite networks in these bands. Otherwise, this leads to a fragmented regulatory situation within CEPT that would discourage projects and in particular large-scale deployments of terminals, e.g. for broadband services.

2) Asymmetrical situation between spectrum identified for use of uncoordinated FSS earth stations in the Earth-to-space and space-to-Earth directions

Issue:

Within CEPT, there is less spectrum identified for satellite services in Ka band in the space-to-Earth direction than in the Earth-to-space direction.

Proposals to address this issue:

a) Frequency band 17.3-17.7 GHz:

- Study whether the whole band 17.3-17.7 GHz could be made available for the use of uncoordinated FSS earth stations in the space-to-Earth direction, recognising that operation of uncoordinated FSS earth stations close to feeder link earth stations for the BSS Plans (Earth-to-space) may not be feasible. To that end, CEPT and/or ITU studies conducted in preparation for WRC-03 (on HDFSS) should be assessed and completed, if required, with a view to conclude on the sharing feasibility between feeder links for the BSS Plans (Earth-to-space) and FSS (space-to-Earth);
- Results could then be taken into account in an appropriate ECC regulation with a view to consider accommodating uncoordinated FSS earth stations in the space-to-Earth direction;
- As a result, study whether a regime of exemption from individual licensing could be developed in this band, on the basis of ECC/DEC/(06)02 and ECC/DEC/(06)03.

b) Frequency band 17.7-19.7 GHz:

Possible studies to be carried out:

- Taking account of the regulatory situation of the FS in this band, assess the use of the FS in this band in CEPT, including the frequency plans identified in ERC/REC 12-03, with a view to identifying the feasibility of enhanced operations of uncoordinated FSS earth stations in the band 17.7-19.7 GHz;
- In particular, study the feasibility of using gaps between the paired FS frequencies, , taking into account channelling arrangements including those described in ERC/REC 12-03;
- As a result, study whether a regime of exemption from individual licensing could be developed with in appropriate sub-bands within this band (as identified, if any, from the above studies)

3) Additional exemption from individual licensing for satellite terminals

Issue:

Within CEPT, in ka band, a regime of exemption from individual licensing is in place only in the bands 29.5-30 GHz and 19.7-20.2 GHz (ECC/DEC/(06)02 and ECC/DEC (06)03), which limits the possibilities to deploy satellite terminals on a large-scale, e.g. for broadband services.

Due to the rapidly growing demand for Ka band satellite services foreseen in the next years, having individual licensing of satellite terminals would suppose an enormous administrative work that would definitely affect to the development of broadband services. There is also a high risk of collapsing the licensing system if a great number of users demand the individual frequency coordination process. Finally, this licensing process will also increase the overall cost of the service to the users. This exemption from individual licensing in additional Ka frequency bands will help the future needs of Ka band satellite service to be met, in term of small antenna services deployment, and in consequence encourage the deployment of broadband terminals on a large scale in CEPT.

The studies proposed in this report should take into account the spectrum requirements as well as adequate protection of existing and future fixed radio service systems in Europe. Information on these systems is provided, amongst others, in ECC Report 003 and associated material related to the update of ECC Report 003.

Proposals and options to address this issue:

a) Frequency band 27.5-29.5 GHz:

- Assess the use of the FS in the band 28.8365-28.9485 GHz (112 MHz in which FS stations were “grandfathered” or those countries where relevant parts of the Decision have not been implemented), in particular in the countries referred to in Decides 2 of ECC/DEC(05)01;
- Study whether this band could be made available for the use of uncoordinated FSS earth stations without constraints. (Remark: this would bring the amount of spectrum designated to uncoordinated FSS earth stations within the band 27.5-29.5 GHz to 992 MHz, while leaving 1120 MHz for FS stations);
- Study whether a regime of exemption from individual licensing could be developed in the sub-bands identified for the use of uncoordinated FSS earth stations (“band segmentation” of ECC/DEC(05)01): 27.5-27.8285 GHz, 28.4445-28.8365 GHz and 29.4525-29.5 GHz, possibly including 28.8365-28.9485 GHz - the above mentioned 112 MHz - depending on the results of above mentioned studies), on the basis of ECC/DEC/(06)02 and ECC/DEC/(06)03;

In conducting this exercise, the situation in some countries where, for example auctions have taken place, should be described and taken into account. This may constrain/limit the deployment of satellite terminals in these countries.

b) Frequency band 17.3-17.7 GHz:

- Addressed above.

c) Frequency band 17.7-19.7 GHz:

- Addressed above.

4) Possibilities to accommodate mobile applications in Ka band

Issue:

ECC Decisions addressing satellite communications in the Ka band apply only to the FSS. Mobile applications cover for example broadband connectivity to mobile platforms such as ships, aircrafts and trains. It is noted that the situation in the C- and Ku bands enables, under certain regulatory, technical and operational conditions, earth stations on board vessels (ESV) and aircraft earth stations (AES) to operate using transponders in the fixed satellite service while protecting existing FSS, FS and other users. It is noted that the accommodation of various mobile applications was the subject of extensive consideration at CEPT, in ITU-R Study Groups and at WRCs over many years.

It was also noted that WRC-12 agenda item 1.25 deals with additional MSS allocations with focus between 4-16 GHz.

Proposals to address this issue:

In order to facilitate introduction of mobile platforms in Ka band FSS allocations, studies should be undertaken to determine the regulatory, technical and operational conditions under which such mobile platforms can be treated as typical uncoordinated FSS earth stations (thereby considering them as fixed/nomadic).

6 CONCLUSIONS

A high level of implementation of ECC Decisions is beneficial to minimise the regulatory burden on Ka band satellite systems and to ensure the development of such satellite networks, including in particular large-scale deployments of terminals, e.g. for broadband services.

A regime of exemption from individual licensing for earth stations operating in the band 29.5 - 30 GHz paired with 19.7 - 20.2 GHz, along with the available bands for uncoordinated earth stations in the 27.5 - 29.5 GHz range paired with 17.3 - 17.7 GHz, is beneficial to the development of satellite systems in Ka band.

ECC Decision	Proposed actions by WGFM in bands where these ECC Decisions apply
ECC/DEC/(05)01	• Assess the use of the FS in the band 28.8365-28.9485 GHz (112" or those countries where relevant parts of the Decision have not been implemented), in particular in the countries referred to in Decides 2 of ECC/DEC(05)01; • Study whether this band could be made available for the use of uncoordinated FSS earth stations without constraints. (Remark: this would bring the amount of spectrum designated to uncoordinated FSS earth stations within the band 27.5-29.5 GHz to 992 MHz, while leaving 1120 MHz for FS stations); • Study whether a regime of exemption from individual licensing could be developed in the sub-bands identified for the use of uncoordinated FSS earth stations ("band segmentation" of ECC/DEC(05)01): 27.5-27.8285 GHz, 28.4445-28.8365 GHz and 29.4525-29.5 GHz, possibly including 28.8365-28.9485 GHz - the above mentioned 112 MHz - depending on the results of above mentioned studies), on the basis of ECC/DEC/(06)02 and ECC/DEC/(06)03; In conducting this exercise, the situation in some countries where, for example auctions have taken place, should be described and taken into account. This may constrain/limit the deployment of satellite terminals in these countries.
ECC/DEC/(05)08	• Study whether the whole band 17.3-17.7 GHz could be made available for the use of uncoordinated FSS earth stations in the space-to-Earth direction, recognising that operation of uncoordinated FSS earth stations close to feeder links earth stations for the BSS Plans (Earth-to-space) may not be feasible. To that end, CEPT and/or ITU studies conducted in preparation for WRC-03 (on HDFSS) should be assessed and completed, if required, with a view to conclude on the sharing feasibility between feeder links for the BSS Plans (Earth-to-space) and FSS (space-to-Earth); • Results could then be taken into account in an appropriate ECC regulation with a view to consider accommodating uncoordinated FSS earth stations in the space-to-Earth direction; • As a result, study whether a regime of exemption from individual licensing could be developed in this band, on the basis of ECC/DEC/(06)02 and ECC/DEC/(06)03.
ECC/DEC/(06)02	See Level of implementation of ECC Decisions above.
ECC/DEC/(06)03	See Level of implementation of ECC Decisions above.
ERC/DEC/(00)07	Possible studies to be carried out: • Taking account of the regulatory situation of the FS in this band, assess the use of the FS in this band in CEPT, including the frequency plans identified in Recommendation 12-03, with a view to identifying the feasibility of enhanced operations of uncoordinated FSS earth stations in the band 17.7-19.7 GHz; • In particular, study the feasibility of using gaps between the paired FS frequencies, taking into account channelling arrangements including those described in Recommendation 12-03; • As a result, study whether a regime of exemption from individual licensing could be developed within appropriate sub-bands within this band (as identified, if any, from the above studies)
New ECC Decisions	• To be decided in light of the above studies and actions proposed. • Consider new ECC Decision defining the technical, operational and regulatory conditions under which mobile platforms operating in FSS allocations can be treated as typical uncoordinated FSS earth stations.

Table 10: Summary of proposed actions in relation to ECC Decisions

Sub-band	Proposed actions by WGFM in relation to these sub-bands
17.3-17.7 GHz	• Study whether the whole band 17.3-17.7 GHz could be made available for the use of uncoordinated FSS earth stations in the space-to-Earth direction, recognising that operation of uncoordinated FSS earth stations close to feeder links earth stations for the BSS Plans (Earth-to-space) may not be feasible. To that end, CEPT and/or ITU studies conducted in preparation for WRC-03 (on HDFSS) should be assessed and completed, if required, with a view to conclude on the sharing feasibility between feeder links for the BSS Plans (Earth-to-space) and FSS (space-to-Earth); • Results could then be taken into account in an appropriate ECC regulation with a view to consider accommodating uncoordinated FSS earth stations in the space-to-Earth direction; • As a result, study whether a regime of exemption from individual licensing could be developed in this band, on the basis of ECC/DEC/(06)02 and ECC/DEC/(06)03.
17.7-19.7 GHz	Possible studies to be carried out: • Taking account of the regulatory situation of the FS in this band, assess the use of the FS in this band in CEPT, including the frequency plans identified in Recommendation 12-03, with a view to identifying the feasibility of enhanced operations of uncoordinated FSS earth stations in the band 17.7-19.7 GHz; • In particular, study the feasibility of using gaps between the paired FS frequencies, taking into account channelling arrangements including those described in Recommendation 12-03; • As a result, study whether a regime of exemption from individual licensing could be developed within appropriate sub-bands within this band (as identified, if any, from the above studies).
19.7-20.2 GHz	See Level of implementation of ECC Decisions above.
27.5-29.5 GHz	• Assess the use of the FS in the band 28.8365-28.9485 GHz (112 MHz or those countries where relevant parts of the Decision have not been implemented), in particular in the countries referred to in Decides 2 of ECC/DEC(05)01; • Study whether this band could be made available for the use of uncoordinated FSS earth stations without constraints. (Remark: this would bring the amount of spectrum designated to uncoordinated FSS earth stations within the band 27.5-29.5 GHz to 992 MHz, while leaving 1120 MHz for FS stations); • Study whether a regime of exemption from individual licensing could be developed in the sub-bands identified for the use of uncoordinated FSS earth stations ("band segmentation" of ECC/DEC/(05)01): 27.5-27.8285 GHz, 28.4445-28.8365 GHz and 29.4525-29.5 GHz, possibly including 28.8365-28.9485 GHz - the above mentioned 112 MHz - depending on the results of above mentioned studies), on the basis of ECC/DEC/(06)02 and ECC/DEC/(06)03; In conducting this exercise, the situation in some countries where, for example auctions have taken place, should be described and taken into account. This may constrain/limit the deployment of satellite terminals in these countries.
29.5-30 GHz	See Level of implementation of ECC Decisions above.
Bands TBD (as a result of studies) for mobile applications	Study the technical, operational and regulatory conditions under which mobile platforms operating in FSS allocations can be treated as typical uncoordinated FSS earth stations.

Table 11: Summary of proposed actions for each sub-band within the bands 27.5-30 GHz and 17.3-20.2 GHz

ANNEX 1 : DESCRIPTION OF THE SATELLITE DATA RELAY FUNCTION

The satellite data relay function represents an important field of satellite applications.

A generic Data Relay System is aimed at providing advantages to users in the following areas:

- a significant increase in coverage area over that provided by existing conventional earth station networks;
- a reduction or virtual elimination of the need for on-board data storage;
- a reduction or virtual elimination of any time delay between transmission of the data from the User spacecraft and their reception by end users on the ground;
- a minimisation of secondary data distribution problems on the ground and
- an increased flexibility in scheduling operations for the users.

A generic data relay satellite (DRS) system is composed of a space and ground infrastructure. It provides the following quasi continuous services:

i) Communication service:
- relay of scientific payload data from low Earth orbiting spacecraft to the ground station;
- relay of video and voice between manned or unmanned low Earth orbiting spacecraft and user spacecraft control centres;
- relay of telemetry and telecommand between user spacecraft control centres and user spacecraft in low Earth orbit;

ii) Localisation service:
- the capability to carry out ranging operations for orbit determination of user spacecraft.

To meet these objectives, the principal elements of the data relay system (DRS) are:

- The DRS satellite (DRSS), in geostationary Earth orbit so as to provide wide coverage for relay of data and ranging signals between earth terminals and user spacecraft in low Earth orbit over as much of their orbits as possible.
- The DRS management facilities, which manage both the setting up and the maintenance of the telecommunication links.

The user systems include:
- User space terminals (UST), comprising the receivers, transmitters and antennas mounted on the User spacecraft in low Earth orbit (LEO), nominally up to 1000 Km of altitude,
- User earth terminals (UET), which receive data from the User spacecraft via the DRS satellite and may also transmit data and commands to the User spacecraft via the DRS satellite.

The communications links consist of two parts: the Feeder Links between the earth terminals and DRSS and the inter-orbit links (IOL) between DRSS and the user space terminals. Links in the direction Earth-DRSS-user spacecraft are called forward links, and links in the direction user spacecraft-DRSS-Earth are called return links. These links are shown schematically below.

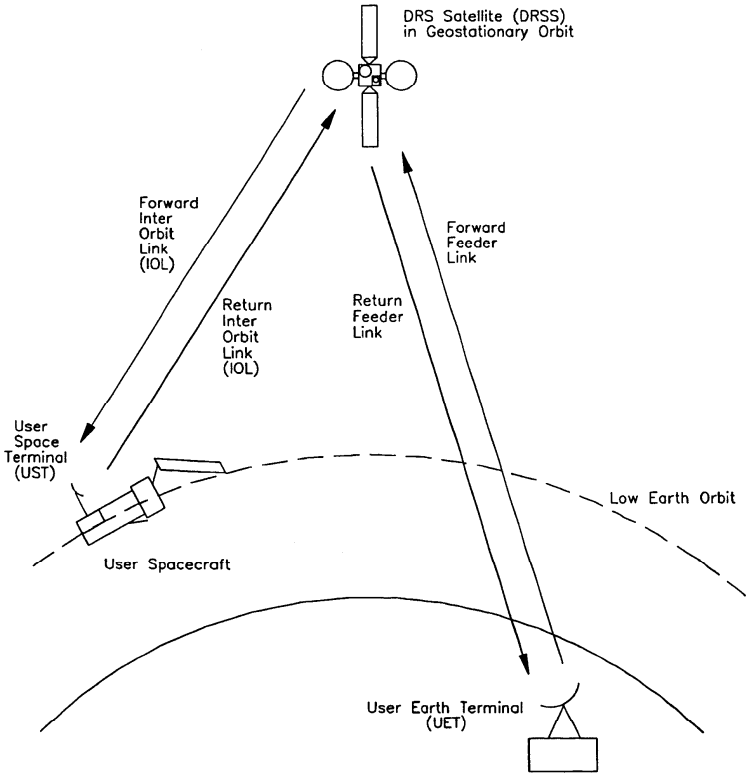

Figure 5: ESA satellite data relay

The bands 27.5-30 GHz and 17.3-20.2 GHz are well suited for providing respectively the forward and return feeder links between the DRS satellite and the user earth terminals.

A description of the data relay satellite ARTEMIS designed and launched by ESA is provided in Annex 3, follow-on plans are described in Annex 6.

ANNEX 2 : MARKET, SUBSCRIBER AND MARKET RAMP-UP FORECASTS FOR SATELLITE BROADBAND IN CEPT

Market, subscriber and market ramp-up forecasts from three different studies are provided in this Annex. These studies are based on different assumptions and methodologies, therefore the results are accordingly different. However, there is a clear trend common to these three studies that the demand for Ka band satellite services in CEPT will be significant.

2.1 STUDY 1 (NSR)

In its Broadband Satellite Markets, NSR[8] provides a worldwide analysis of industry trends and market forecasts over ten years.

With regard to broadband market for satellite, the results that NSR provides in its report do not express the market potential for satellite, nor the estimation of the evolution of sizes of addressable market over the years. Their forecasts are based on the evolution of deployment of the infrastructures, terrestrial and satellite, existing and planned ones.

For the European regions, NSR is closely watching the evolution of economic conditions and the different initiatives there that have been developed at national and regional levels for the building of broadband as universal service. NSR is also paying attention to the roll-out of competitive technologies, especially WiMAX.

NSR considers that from 2011, the number of satellite broadband subscribers and the broadband demand will significantly increase due to the availability of the KA-SAT and HYLAS satellites (both dedicated to Ka band consumer market broadband access in CEPT) that are estimated to be fully operational by then.

The following figure shows NSR forecast of Single Site Satellite broadband subscribers (in thousands) from 2008 to 2018:

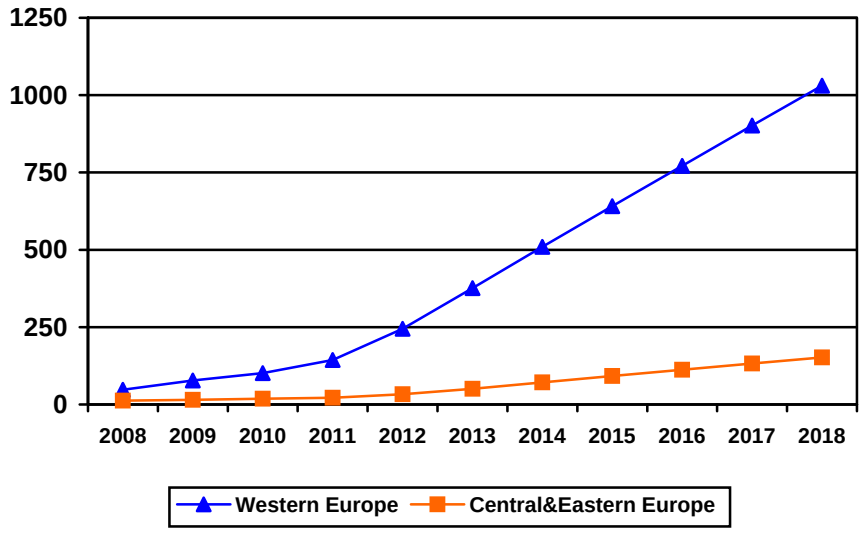

Figure 6: Broadband Satellite Markets, 8th edition
(Source: NSR, April 2009)

NSR estimates that in 2018 satellite broadband will reach over 1 million broadband subscribers in Western Europe and about 150,000 in Central and Eastern Europe.

[8] NSR or Northern Sky Research is an international market research and consulting that is specialized in telecommunications technology, with a particular focus on satellite and wireless networks, emerging technology and media applications. Their mission is based on giving their clients in-depth market forecasts in order to consider and plan future perspectives and opportunities in the market.

NSR also presents the Forecast of Single Site Satellite broadband bandwidth demand in Ka band (in Gbps) based on the assumption that KA SAT and HylasOne will be fully operational in 2011:

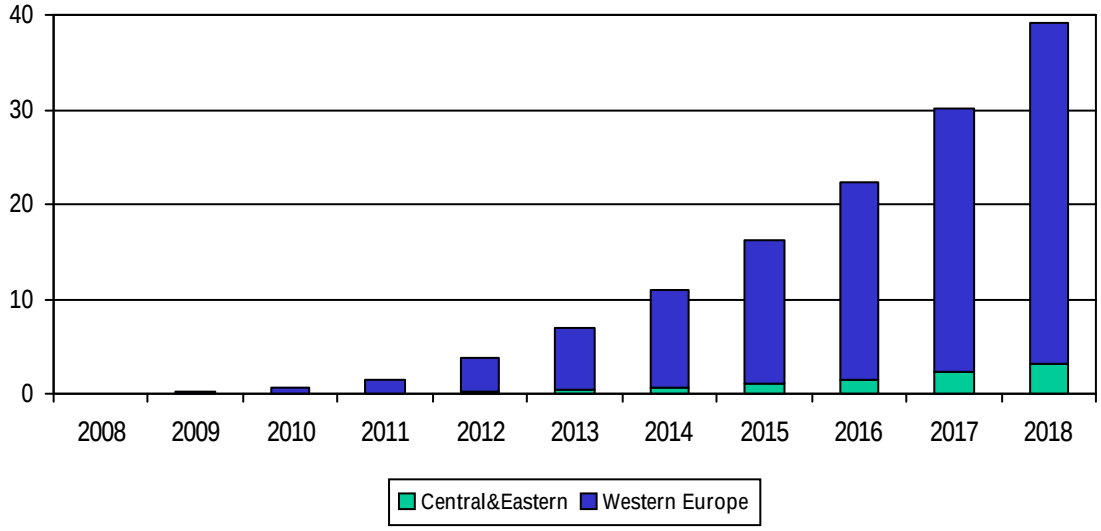

Figure 7: Broadband Satellite Markets, 8th edition
(Source: NSR, April 2009)

The bandwidth demand will increase up to nearly 40 Gbps over Europe by 2018.

NSR considers that single site satellite broadband services have the potential to represent one of the great success stories of the satellite industry.

Western Europe would be the region with the most important increase with a Compound Annual Growth Rate (CAGR) of 33.4% and for Central & Eastern Europe region they forecast a CAGR of 17.2%, which means that satellite broadband market could generate $930 million revenues in Europe by 2018.

2.2 STUDY 2 (SES ASTRA)

2.2.1 Market forecasts

Un-served market is defined as the satellite broadband core addressable market which is composed by households with the following characteristics

- Capable to pay satellite Internet total cost of ownership
- Which do not have access to ADSL
- Which do not have access to WiMax
- Which are willing to get an internet access

Under-served market is defined as the satellite broadband extended addressable market which is composed by households with the following characteristics

- Which have access to ADSL limited to download speed of 512Kbps to 1Mbps
- Which do not have access to WiMax
- Which are willing to get an internet access

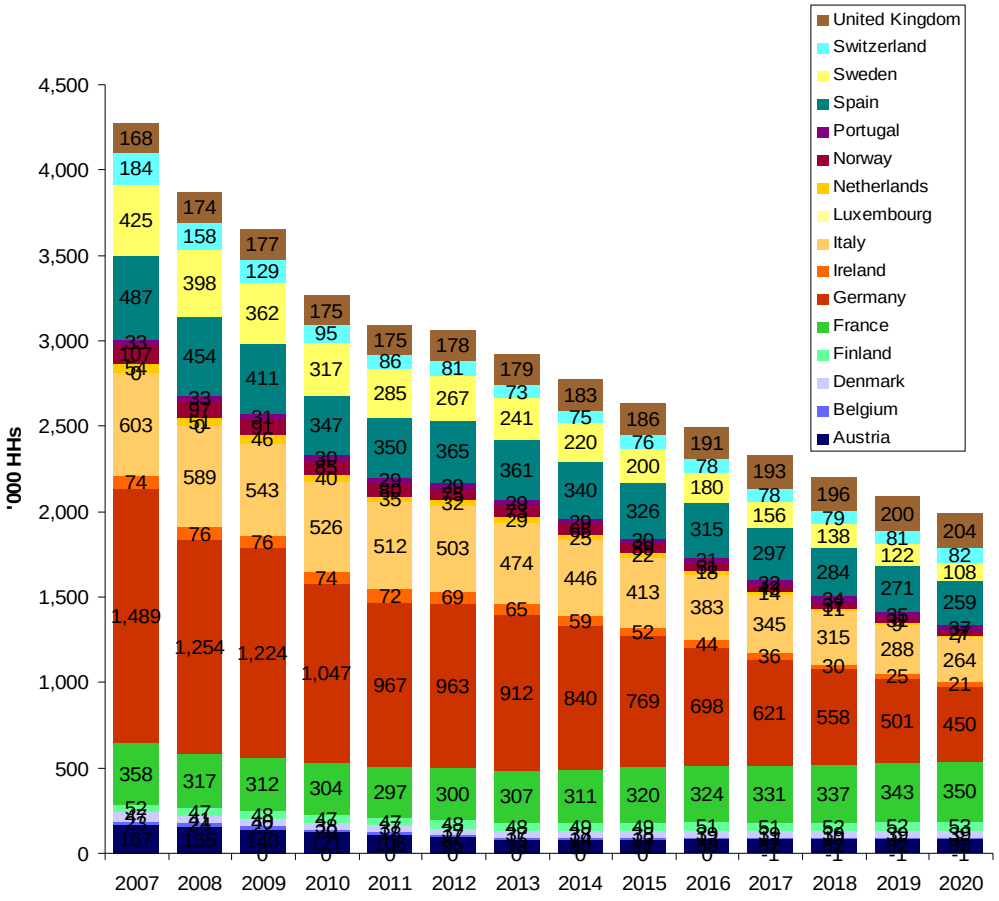

Figure 8: Un-served market – Western Europe forecast
(Source: SES ASTRA compilation of external sources -2009)

Figure 8 shows that the Western Europe addressable market is decreasing with the deployment of ADSL and Wimax.

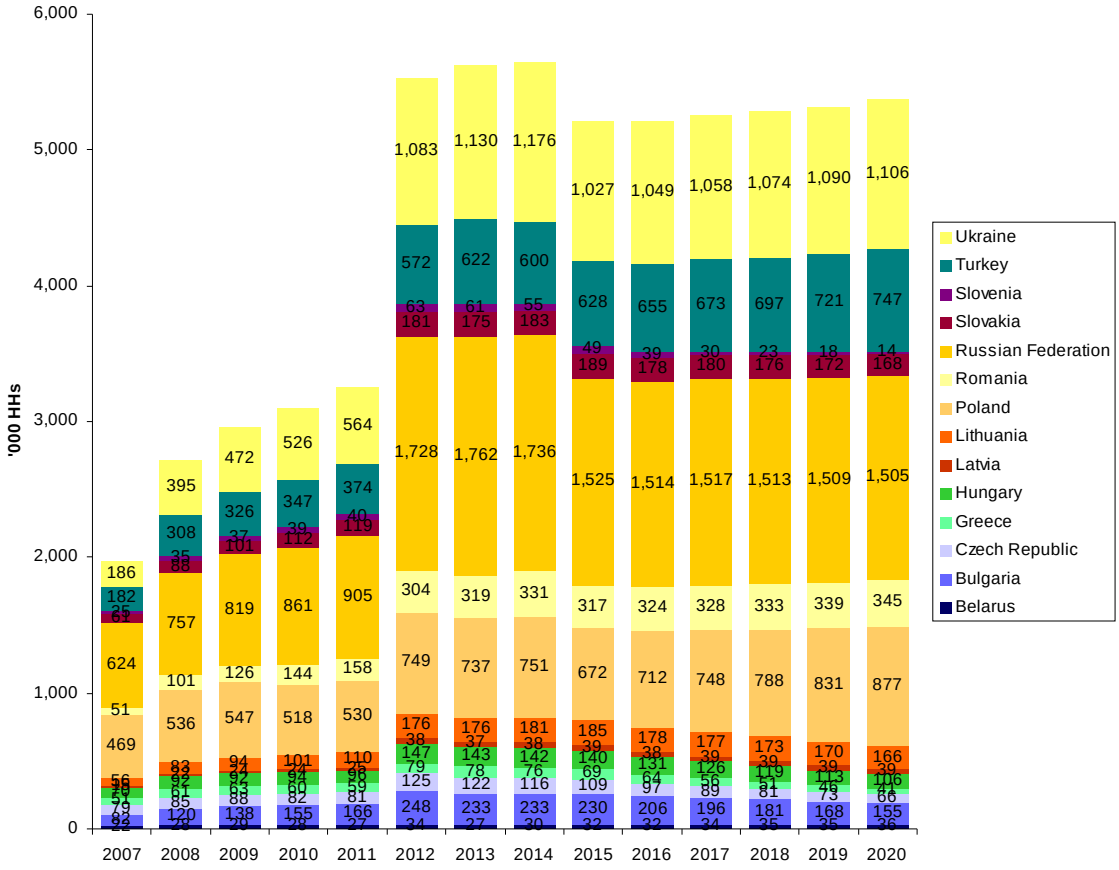

Figure 9: Un-served market – Eastern Europe forecast
(Source: SES ASTRA compilation of external sources -2009)

Figure 9 shows that:

- the increase of addressable market in 2012 due to lower end-user terminal cost provided by a lower cost of Ka band payload
- the addressable market stay flat
    - Negative influence due to increase ADSL coverage
    - Positive influence due to increase of internet penetration in eastern European countries

2.2.2 Subscribers forecasts

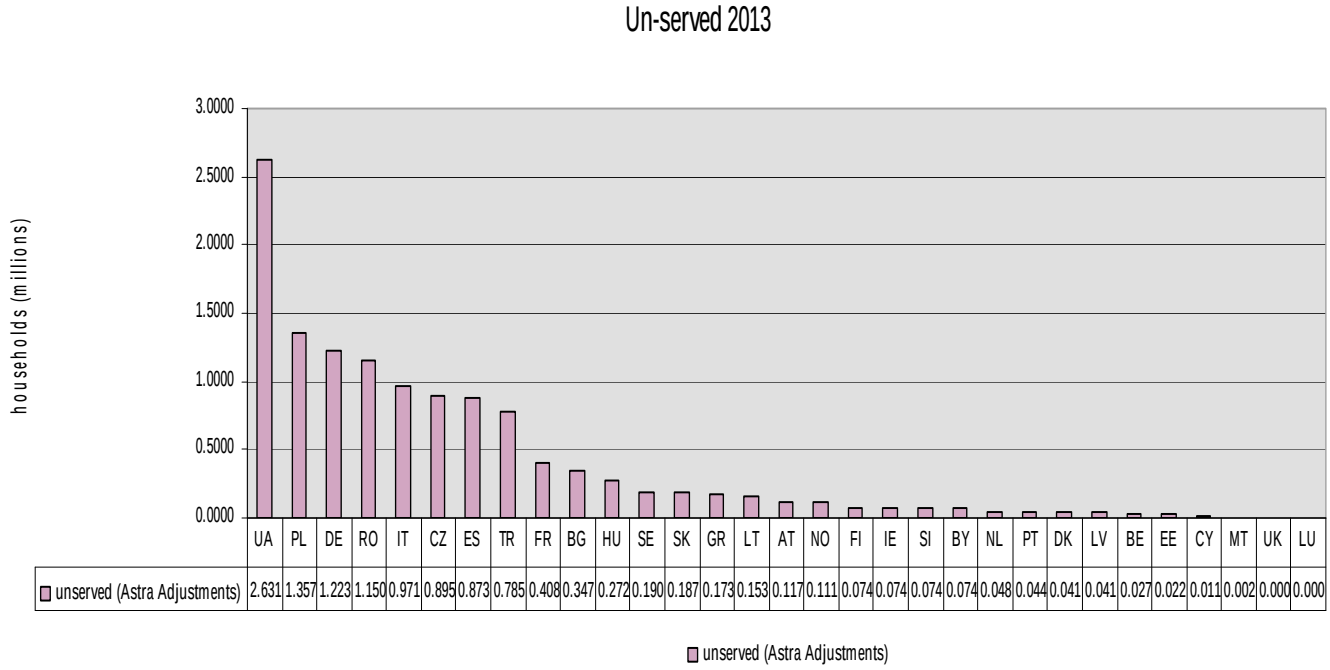

Figure 10: Un-served Market expected in 2013
(Source: SES ASTRA compilation of external sources -2009)

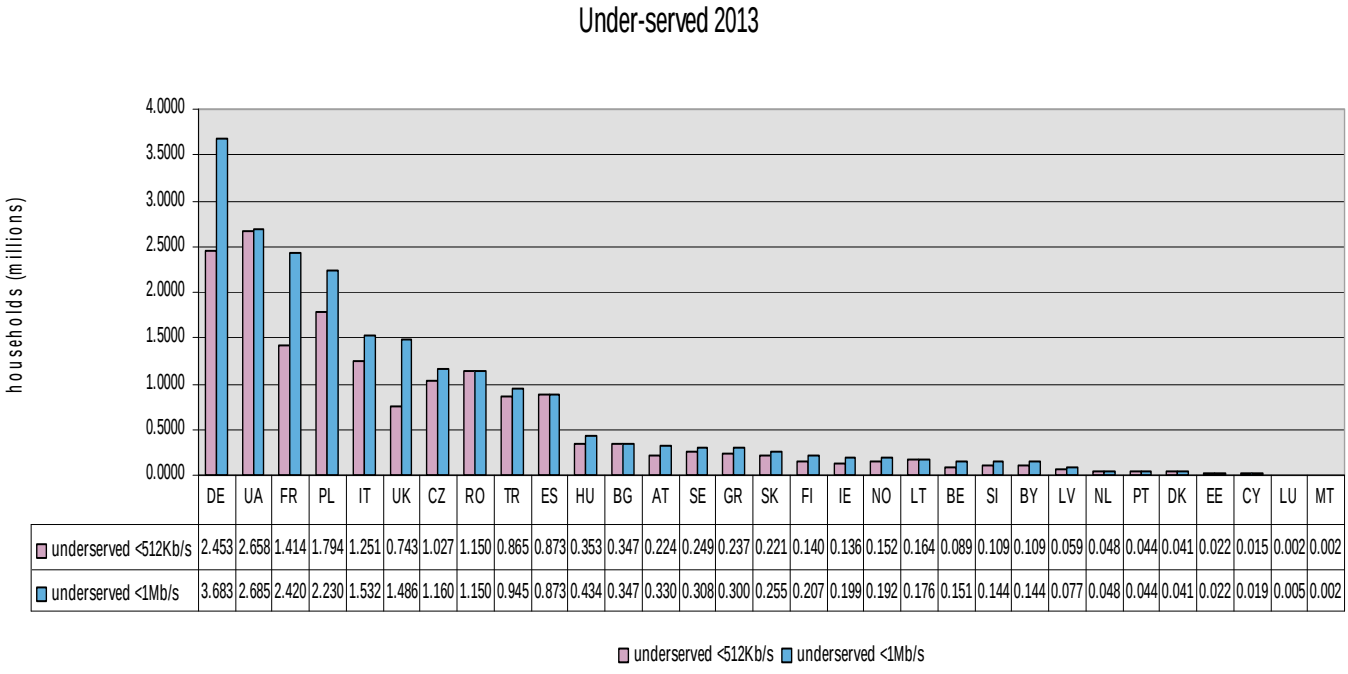

Figure 11: Under-served Market expected in 2013
(Source: SES ASTRA compilation of external sources -2009)

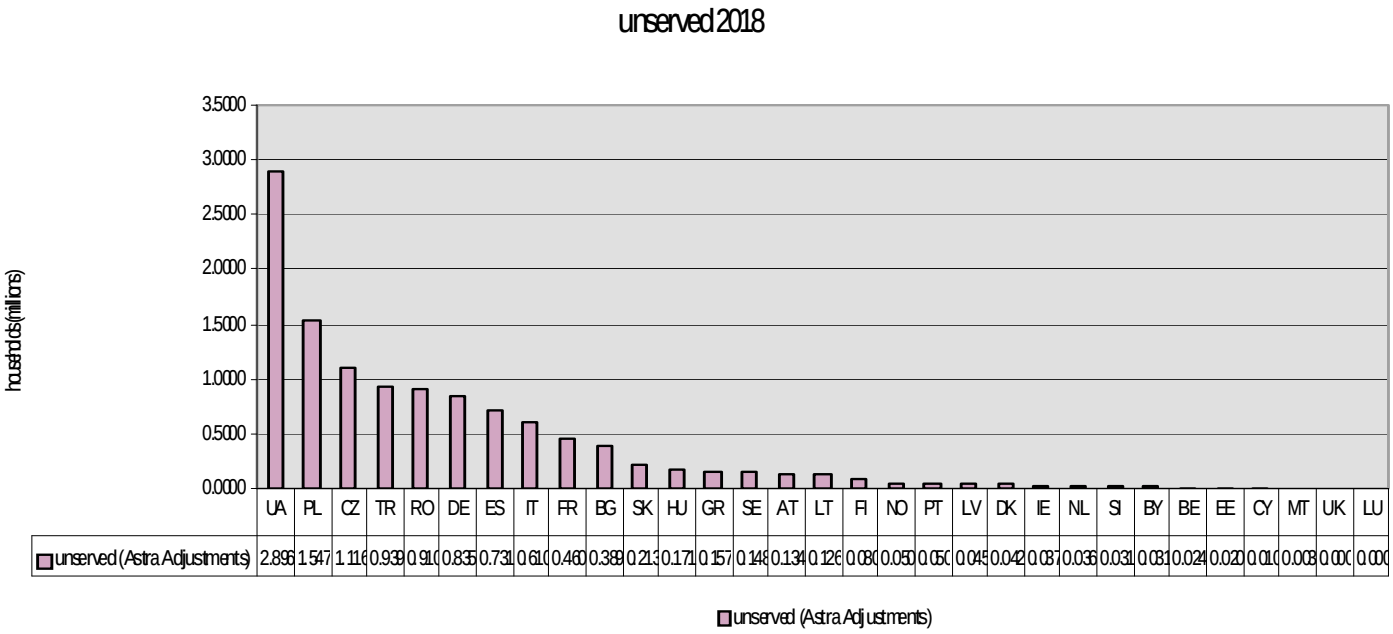

Figure 12: Un-served Market expected in 2018
(Source: SES ASTRA compilation of external sources -2009)

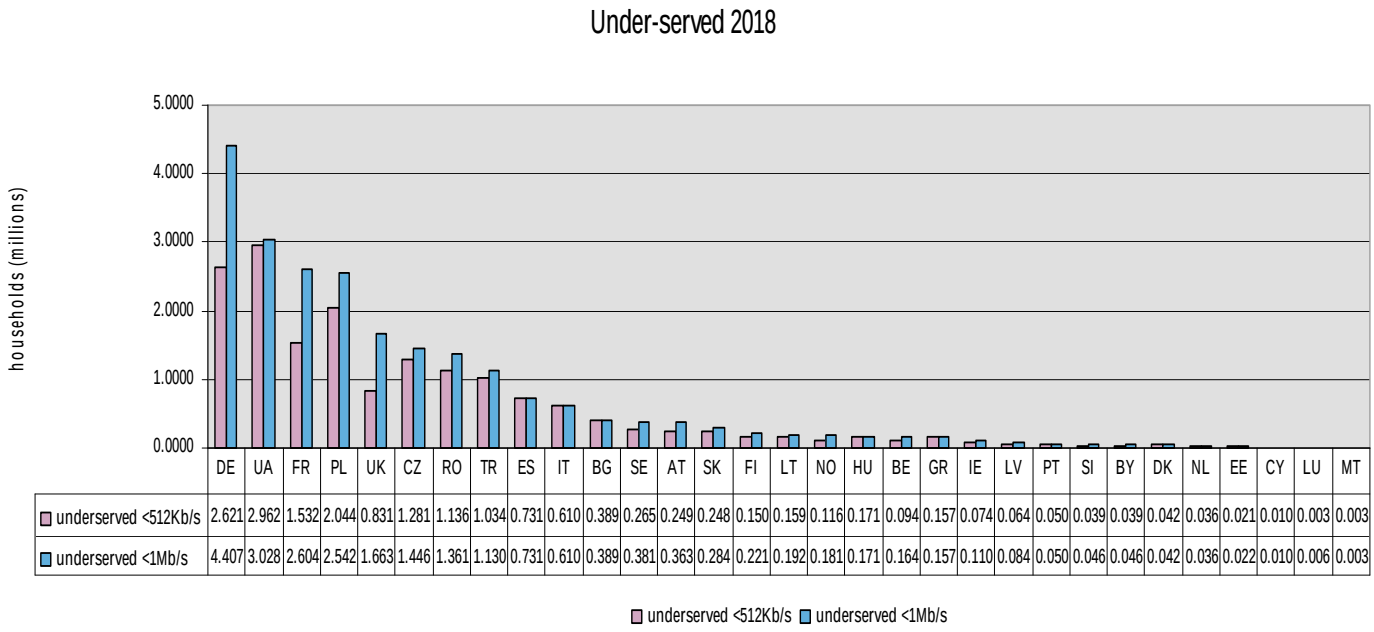

Figure 13: Under-served Market expected in 2018
(Source: SES ASTRA compilation of external sources -2009)

2.2.3 Market ramp-up

With the assumption that Ku Band subscribers are converted to Ka band products at no cost from 2012 onwards, three scenarios of market ramp-up for broadband access are considered below:

- Low: 1% of the addressable market is captured per year
- Medium: 2% of the addressable market is captured per year, as Wildblue addressable market in 2008 over North America
- High: 3% of the addressable market is captured per year

Capture rate is applied to all Western Europe and Eastern Europe countries including Turkey but excluding Russia.

2.2.3.1 Low case: 1% of addressable market acquired per year across all European countries

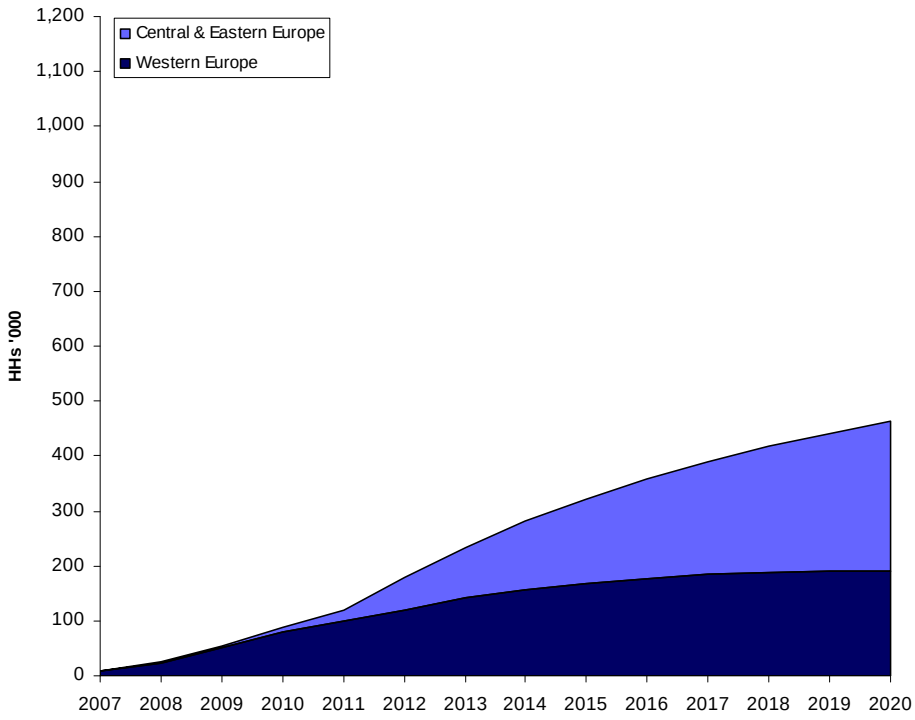

Figure 14: Broadband satellite service subscriber (HH - household) ramp-up - Low case
(Source: SES ASTRA compilation of external sources -2009)

- Western European market reaches saturation at about 190 000 Subscribers due to diminishing addressable market
- Eastern European market stays rather dynamic overtake the Western European market in 2017 and reaches about 250K in 2020
- Total market reaches 440 000 households in 2020

2.2.3.2 Medium case: 2% of addressable market acquired per year across all European countries

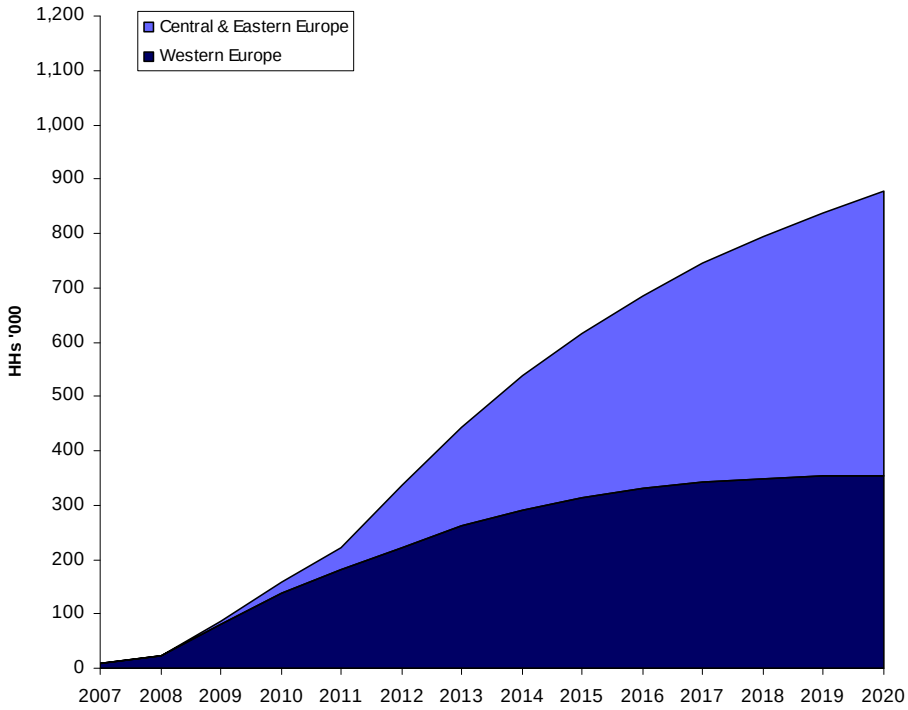

Figure 15: Broadband satellite service subscriber (HH - household) ramp-up - Medium case
(Source: SES ASTRA compilation of external sources -2009)

- Western European market reaches saturation at about 350 000 Subscribers due to diminishing addressable market
- Eastern European market stays rather dynamic overtake the Western European market in 2016 and reaches about 500 000 in 2020
- Total market reaches 850 000 in 2020

2.2.3.3 High case: 3% of addressable market acquired per year across all European countries

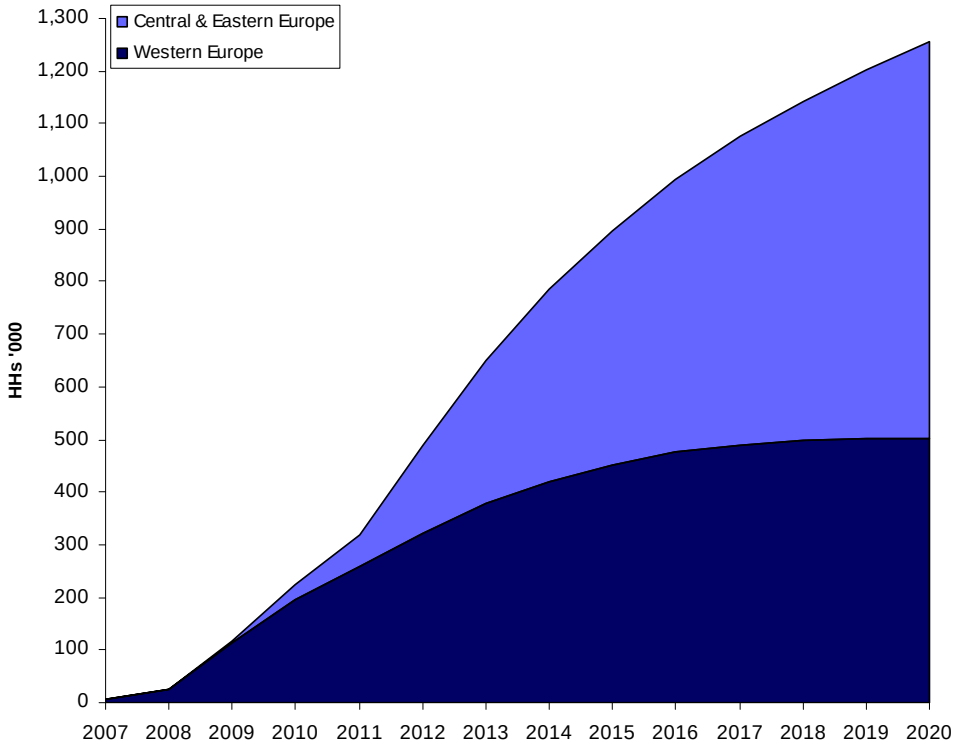

Figure 16: Broadband satellite service subscriber (HH - household) ramp-up - High case
(Source: SES ASTRA compilation of external sources -2009)

- Western European market reaches saturation at about 500 000 Subscribers due to diminishing addressable market
- Eastern European market stays rather dynamic overtake the Western European market in 2016 and reaches about 750 000 in 2020
- Total market reaches 1 250 000 in 2020

2.3 STUDY 3 (EUTELSAT)

2.3.1 Addressable market for satellite broadband

A satellite operator (Eutelsat) has conducted a market estimation, assuming that satellite technology has to consider unserved and underserved households over all the region.

The *unserved* market has been much analyzed by consulting and research firms like IDATE for a majority of countries throughout CEPT. This unserved market concerns the areas that are not covered by any terrestrial broadband service. They usually have a low population density. This unserved market is the primary target market for satellite broadband.

The *underserved* market segment is more difficult to analyze as it concerns the areas where broadband is available but with limited speed. They are usually located in suburban areas. They are an important target market for satellite broadband as satellite is the best positioned technology for covering every spot of the country without additional infrastructure.

This *underserved* market segment is subject to uncertainty as there is not yet any market study that has taken it into account. Therefore, the operator's estimation of this market was based on internal analysis and study.

Assumptions

- For the unserved market, the operator considers households that are not covered by any DSL network. Data come from Idate when available and from the operator's estimation otherwise.
- The underserved market is estimated at 5% of the population, on the basis of previous internal analysis of the operator.
- These estimations of unserved and underserved market are taking only households that own a PC into account.

Results

The following charts show the operator's estimation of the addressable market in Western Europe (including Greece) and in Central & Eastern Europe (including Turkey and the Russian region that will be covered by the KA SAT satellite).

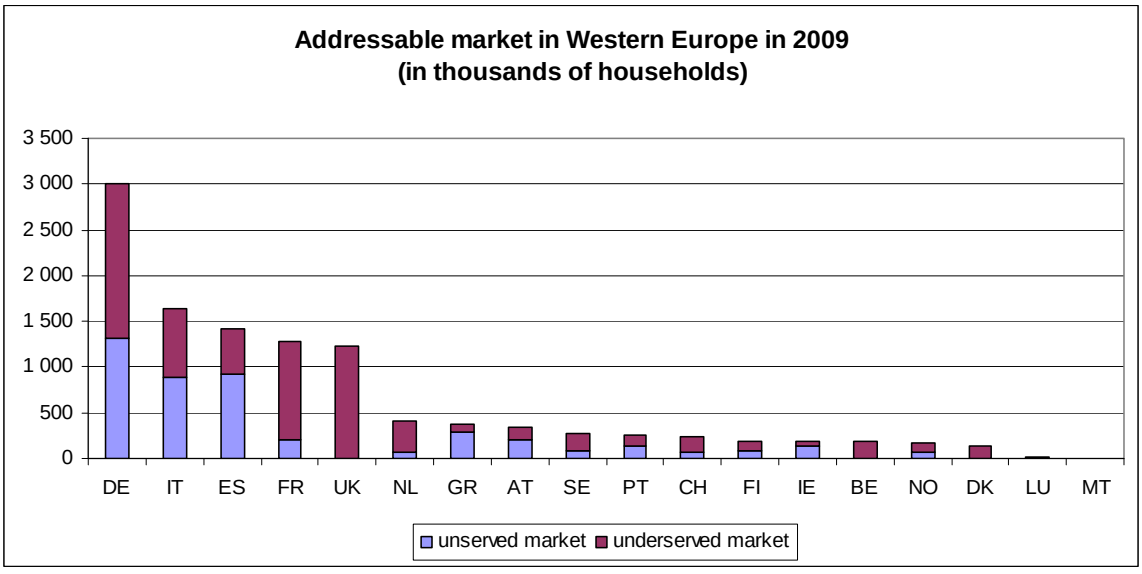

Figure 17: addressable market in Western Europe
(Source: Eutelsat, September 2009)

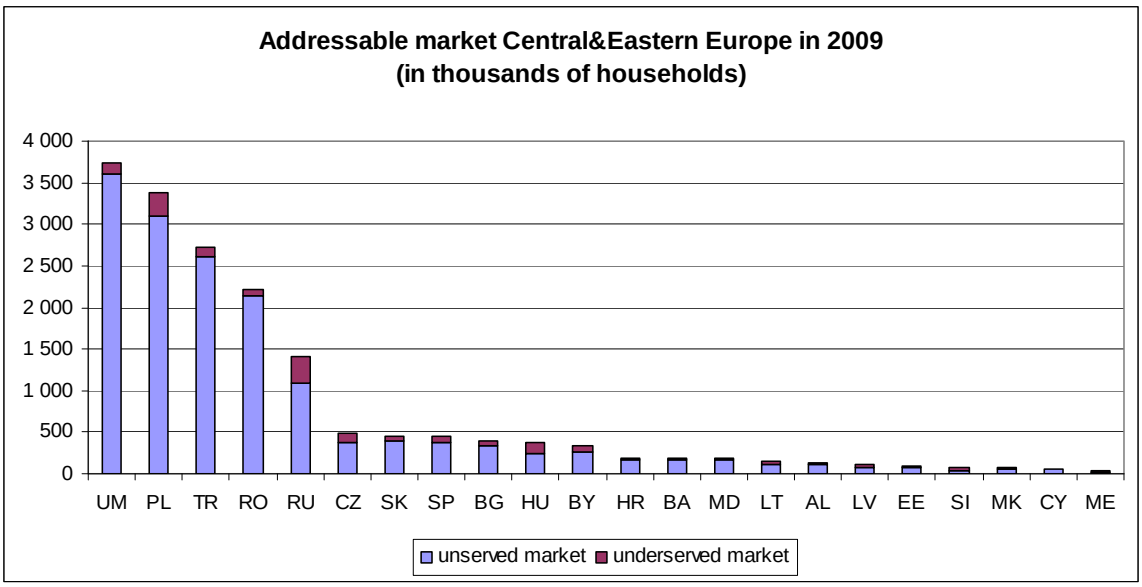

Figure 18: addressable market in Central & Eastern Europe
(Source: Eutelsat, September 2009)

These figures show that the total addressable market in Europe in 2009 for satellite broadband access concerns 28.5 million households that are distributed in the following way:

- 11.3 million households in Western Europe. The target market is mostly the underserved market as DSL networking is much more deployed there, and sometimes covering more than 90% of the territory.
- 17.2 million households in Central & Eastern Europe. The market is mostly the unserved market due to low DSL coverage in these countries.

2.3.2 Satellite operator forecast of satellite broadband market share

This forecast is based on a Eutelsat study.

- This forecast is based on the Bass diffusion model for innovations. Whereas NSR's forecast is based on the capacity of planned satellite infrastructures, this forecast is based on the consumer-adoption process for satellite broadband as an innovation.
- It is assumed that the potential market share for satellite broadband is about 10% of the addressable market previously estimated in Western Europe and 5% in Central & Eastern Europe

The following figure shows the envisaged evolution of satellite broadband subscribers in Europe up to 2020.

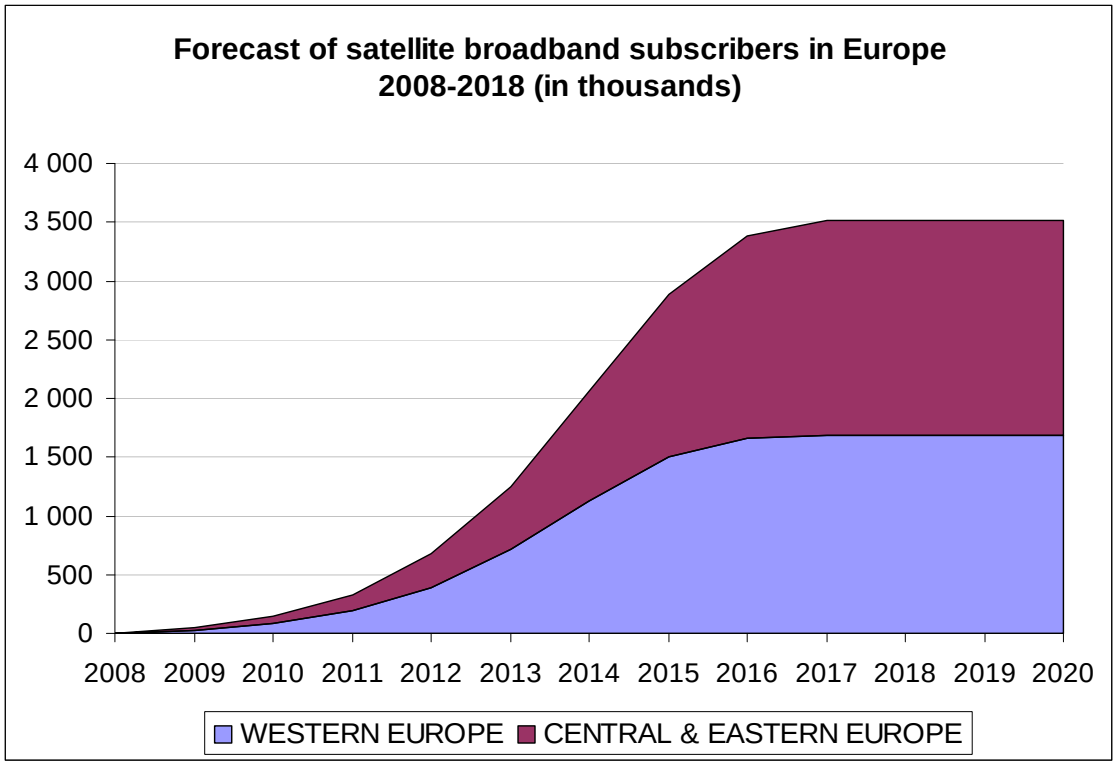

Figure 19: Satellite broadband subscribers in Europe up to 2020

(Source: Eutelsat, September 2009)

- The Western Europe market will reach saturation at about 1.6 million subscribers,
- In Central and Eastern Europe, the market will reach saturation at 1.8 million subscribers
- The total market reaches 3.5 million subscribers in 2018

ANNEX 3 : DESCRIPTION OF OPERATIONAL SATELLITE BROADBAND SYSTEMS IN NORTH AMERICA AND CEPT, AND OF A DATA RELAY SATELLITE SYSTEM IN CEPT

3.1 In North America

3.1.1 In the USA

- **VIASAT, TELESAT and WILDBLUE**

The biggest operational Ka band satellite broadband service in North America is provided by WildBlue in the USA (Telesat in Canada). WildBlue became a wholly-owned subsidiary of ViaSat, Inc. in December 2009.

WildBlue delivers affordable two-way broadband Internet access via satellite to any home and small business in small cities and rural America. WildBlue uses a 66 cm satellite mini-dish equipped with both a transmitter and receiver for two-way satellite connectivity to the Internet. The satellite Telesat's Anik F2 was successfully launched in July 2004 and commercial service for the US and Canada started end June 2005. WildBlue-1, WildBlue's second satellite (co-localised at 111.1 W), was launched in December 2006 based on marketplace demand.

On March 2009, WildBlue and EchoStar Satellite Services announced that the two companies have completed an agreement for WildBlue to lease additional Ka band capacity from EchoStar. This additional capacity will allow Wildblue to serve more customers in high-demand rural areas in U.S. through 2009 and beyond.

The WildBlue satellite Internet connection offered by Blue Speed is available in three packages:

- download speed of 512 Kbps and upload speed 128 Kbps, to serve home customers looking to perform basic tasks such as email activity and browsing
- download and upload speeds of 1.0 Mbps and 200 Kbps
- download speed of 1.5 Mbps and upload speed of 256 Kbps, to serve more serious Internet users and business users carrying out heavy downloading, video and music downloads, file sharing, and multiple tasks.

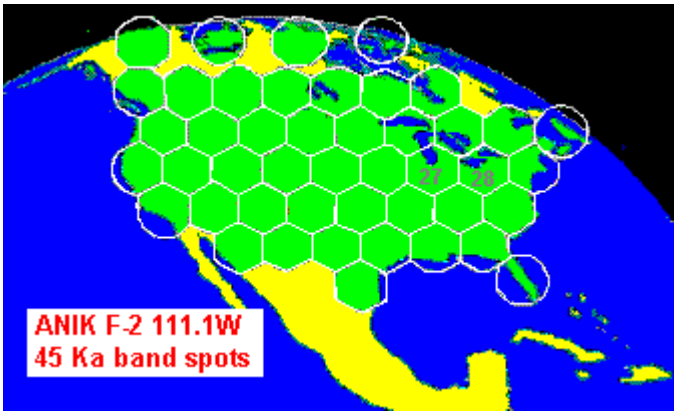

Figure 20: ANIK F-2 111.1 W 45 Ka band spots

ViaSat intends to replace the WildBlue satellites with its VIASAT-1 satellite (at 77 WL), to be launched in 2011. ViaSat-1's 34 spot beams will give the system a total capacity of 100 Gbps. When it replaces the WildBlue satellites, VIASAT-1 will offer WildBlue customers the packages described above at the same price, but with download speeds of up to 2 Mbps, 4 Mbps and 8 Mbps instead of the current 512 kbps, 1 Mbps and 1.5 Mbps.

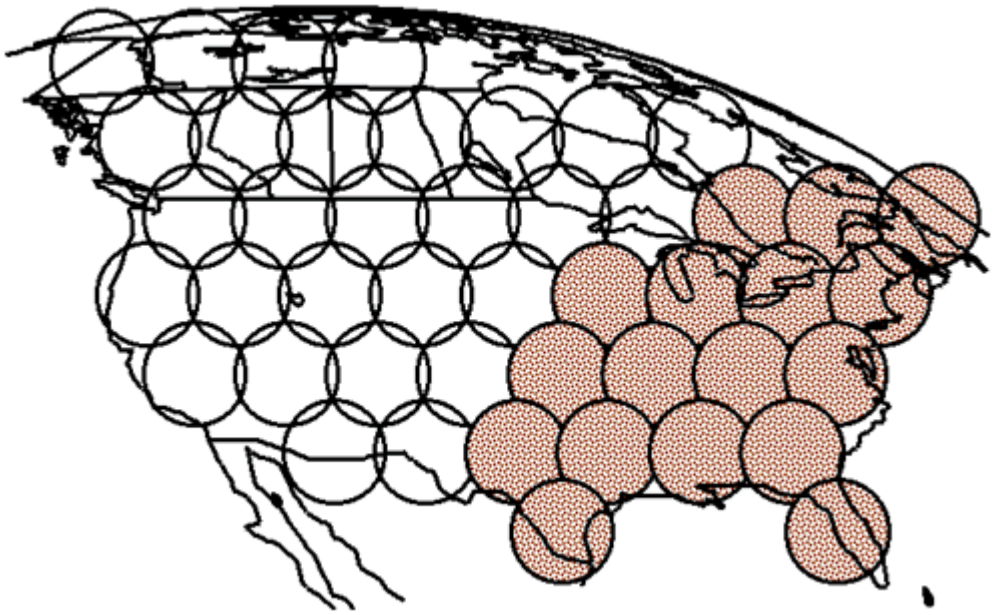

Figure 21: WildBlue-1 spot beam coverage

3.1.2 In Canada

Industry Canada Ka band licences for GSO FSS systems:

Authorisation holder	satellite name	Orbital Position
Telesat Canada	Anik F2	111,1 W
Telesat Canada	Wildblue-1	111,1 W
Telesat Canada	Anik F3	118,7 W
Bell ExpressVu	Nimiq 4	82 W
Telesat Canada	Nimiq 4	82 W

Table 12: Licences for satellites in operation

Applicant	satellite name	Orbital Position
Telesat Canada	Ka	118,7 W
Ciel Satellite	Ciel-3	91 W
Ciel Satellite	Ciel-5	109,2 W

Table 13: Approvals in principle for satellites not yet in operation

3.2 In CEPT

3.2.1 Broadband satellite systems

In CEPT, Ka band satellite broadband services extension is foster by different kinds of needs.

- **SES ASTRA**

The satellite operator SES Astra is already offering Ka band services, including the permanent delivery of live or recorded TV and radio signals to its DTH uplink teleports, from virtually anywhere in CEPT. Astra delivers Ka band services to overcome first-mile connectivity gaps of cable and/or fibre deployment. Indeed, this service is based on its effectiveness, resilience and flexibility compared to cable and/or fibre in rural and other isolated areas, where fibre links would be prohibitively expensive.

An example is SES ASTRA's "Broadband Interactive System" (BBI). The four main targets segments of this broadband system (384-2Mbps) are:

- Content contribution links (building on existing A-Net customers)
- Shared corporate connectivity (i.e. SME LAN access)
- Shared user-community connectivity (i.e. cable operators)
- Shared telecommunication connections

The commercial availability of the BBI service in 2001 was the first commercial broadband satellite service available across CEPT using Ka band (as well as Ku band).

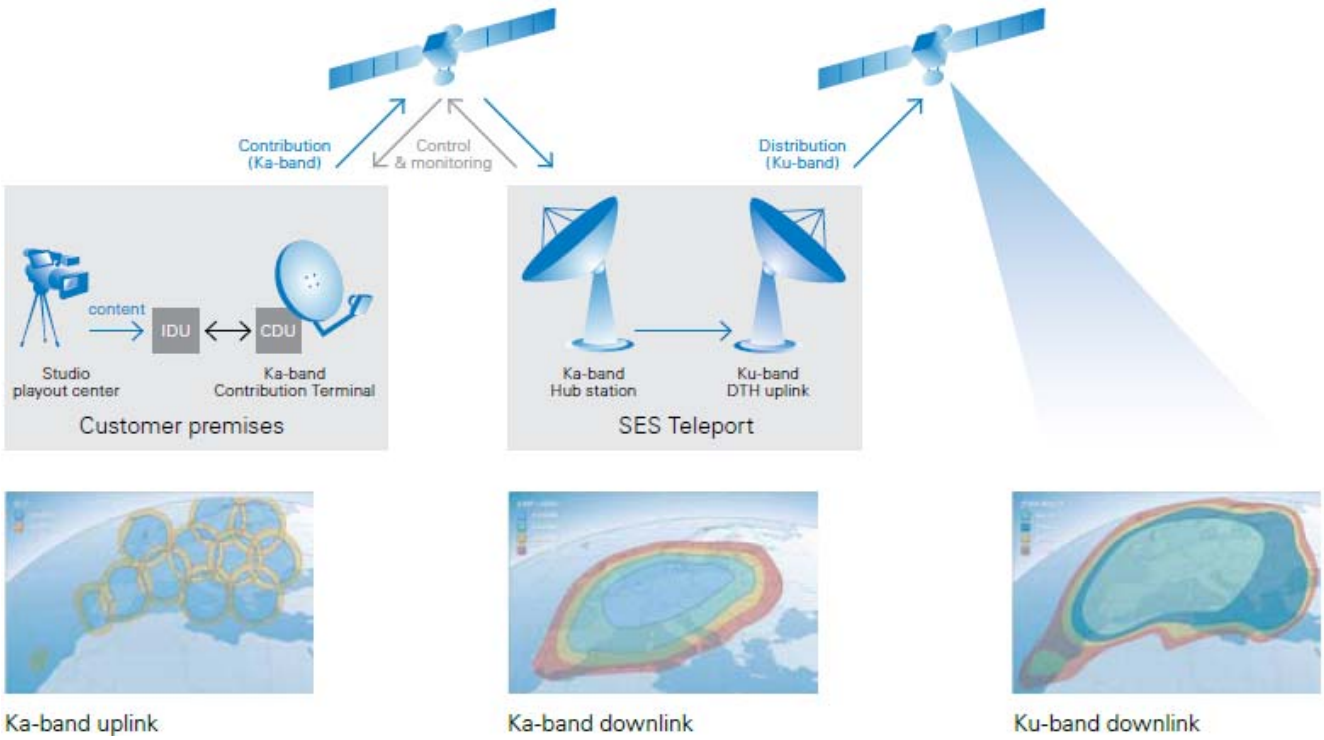

Figure 22: SES Astra service overview (Astra 1H and 1L satellites)

In CEPT, the first Ka band satellite broadband service was implemented by ASTRA 1H (launched in June 1999) and ASTRA 1L (launched in May 2007) which include transponder capacity in the Ka band for return path transmissions from the user to the service provider via the satellite.

ASTRA 1H and ASTRA 1L characteristics are the following ones:

- Orbital location: 19.2° east

- Transponder bandwidth: 500 MHz in Ka band
- ASTRA 1H is equipped with 2 Ka band channels with eight spot beams for satellite return path in 29.50-30.00 GHz (Earth-to-space).
- ASTRA 1L is equipped with 2 Ka band channels in 18.30-18.80 GHz (space-to-Earth) associated to an maximum e.i.r.p. of 51 dBW in the centre of coverage. Both are localised at 19.2° east and cover continental Europe.

SIRIUS 4 also carries a dedicated payload for services in the Ka band. Two transponders will enable new types of applications and give new opportunities in the Nordic and Baltic countries for e.g. interactive services. SIRIUS 4 characteristics are the following ones:

- Orbital location: 4.8° East
- Number of Transponders in Ka band: 2
- Transponder bandwidth: 2 x 125 MHz (Ka Interactive), 250 MHz (Ka Interconnect)
- Downlink Frequency bands: 29.5-30.0/18.8-19.3 GHz (Ka Interactive), 19.7-21.75 (Ka Interconnect)

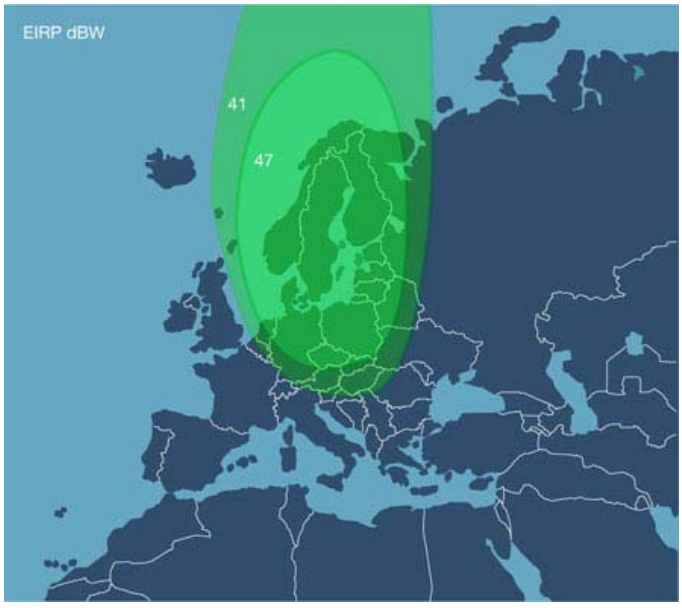

Figure 23: SIRIUS 4 Medium Power (FSS) Nordic beam

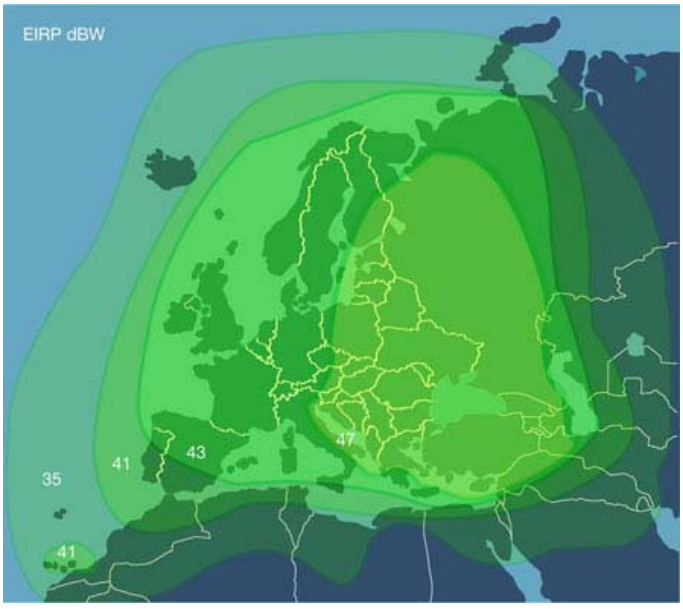

Figure 24: SIRIUS 4 Medium Power (FSS) Pan-European beam

- **EUTELSAT**

In 2007, Eutelsat introduced Tooway™, a service for consumer broadband access via HOT BIRD 6 (Ka band) and EUROBIRD-3 (Ku band)

- HOT BIRD™ 6 (13° East), launched in 2002, was the first European commercial satellite including a Ka band payload.
- EUROBIRD™ 3 (33° East), launched in 2003, was the first Eutelsat satellite specifically designed for broadband applications at Ku band. It covers also the eastern parts of Europe where HOT BIRD™ 6 is not able to provide Ka band Tooway™ services.

The current Tooway™ service over HOT BIRD™ 6 and EUROBIRD™ 3 allows download at up to 3,6 Mbps and upload at up to 512 Kbps.

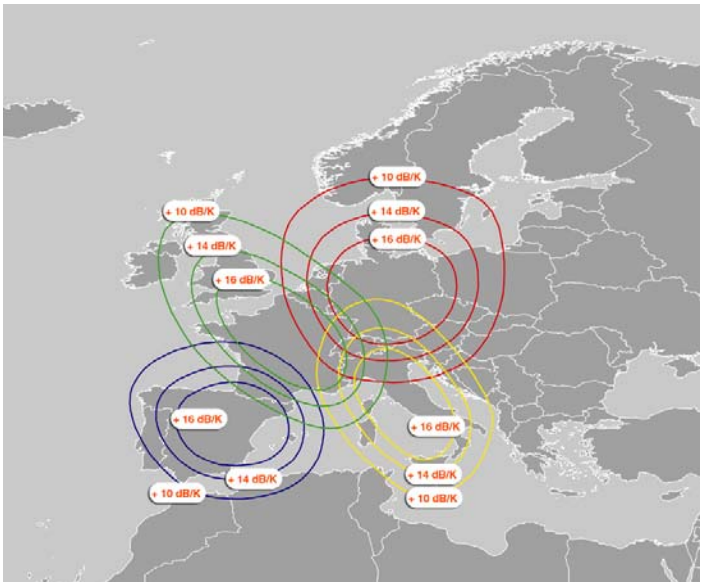

Figure 25: The HOT-BIRD™ Ka Band coverage

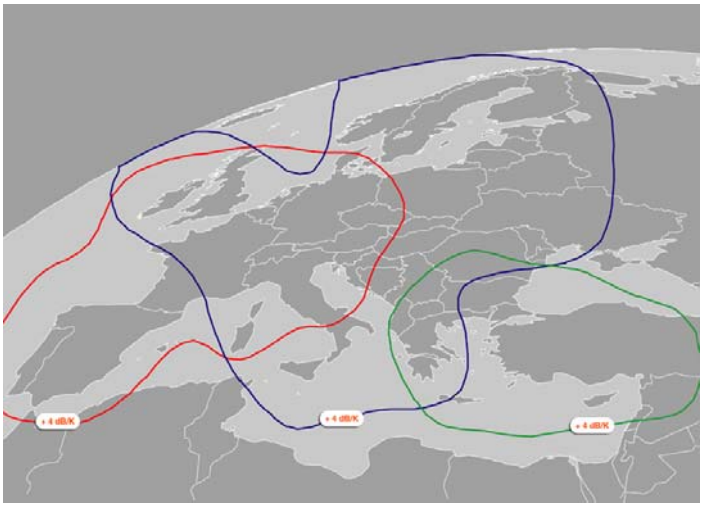

Figure 26: The EUROBIRD™ 3 Ku Band coverage

3.2.2 Feeder applications for the provision of high data rate services

- **EUTELSAT**

The W3A satellite was launched in March 2004 and is operated at 7° East. W3A combines Ku and Ka band frequencies and on-board multi-plexing. It provides pan-European and pan-African coverage and connectivity between the two continents.

The Ku band payload is used for the core European mission and is also used over Africa by employing frequency re-use via spatial isolation.

Since the European mission uses all the Ku band capacity, Ka band is used for communications to and from Europe for the African mission.

The African mission offers two services:

- The pan-African service is basically a regional service and consequently both uplink and downlink use Ku band over Africa.
- The African/European service provides communication links between Africa (using Ku band) and Europe (using Ka band).

The targeted network for the African/European service is of the star type with the hubs being in Europe and the terminals in Africa.

These links are used in Africa for applications such as distance-learning, telemedicine, Internet access and others.

In addition in Europe, a data relay satellite system is operated by ESA.

- **ESA ARTEMIS DATA RELAY SATELLITE SYSTEM**

The ESA Artemis data relay satellite became operational in February 2003 at the geostationary position 21.5 East. It has operated continuously since then in support of several ESA and non-ESA satellite missions.

The main current ARTEMIS user is the ESA satellite ENVISAT, for which Artemis has provided so far more than 31,000 relay connections, corresponding to over 14,000 hours of communication. (Data from August 2009 Artemis Operations Report).
Other users of the Artemis data relay service are ATV, SPOT, USV, Bayernsat. In addition other experimental users exploited and will exploit the Artemis data relay service.
ARTEMIS offers and receives also cross-support from the data relay systems of other space agencies like NASA TDRSS and JAXA DRTS.

The UST localisation capability via ARTEMIS gives accuracy better than 20 m for a typical polar orbiting satellite.

The frequency bands used by Artemis are as follows:

Forward Links:

- Feeder Link:	28.5 -30.0 GHz
- lnter Orbit Link:	2.025 - 2.1 10 GHz 23.12 - 23.55 GHz, 820 nm (optical)

Return Links:

- lnter Orbit Link:	2.200 - 2.290 GHz, 25.25 - 27.50 GHz, 848 nm (optical)
- Feeder Link:	18.10 - 20.20 GHz.

Only the frequencies used for the feeder links (forward and return) are relevant for this ECC Report

ARTEMIS provides up to 2 simultaneous accesses, namely:
- one forward/return 23/26 GHz or 2 GHz access;
- one forward/return optical access.

ARTEMIS provides one operational channel in forward and return direction per IOL access. Moreover, in Ka band return direction, ARTEMIS is able to provide up to 3 operational channels simultaneously.

It is possible to assign to each critical mission, a dedicated forward feeder link frequency that is not to be used by any other mission.

The feeder link coverage of Artemis in Europe is shown in the figure below:

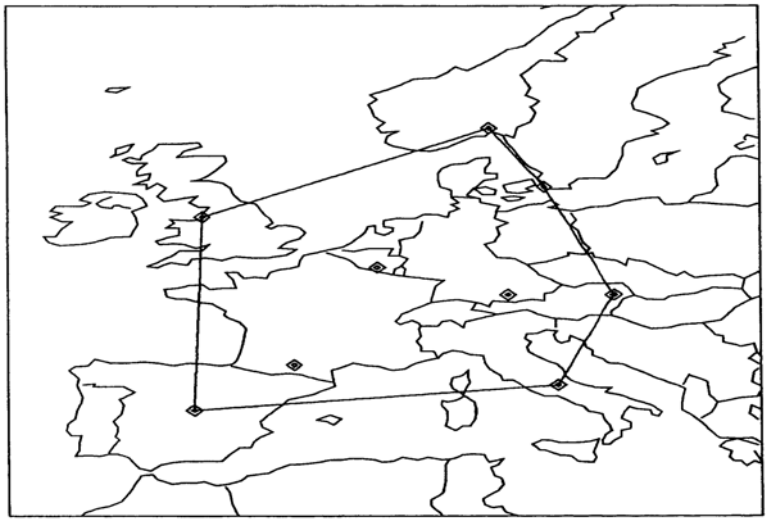

Figure 27: Feeder link coverage of Artemis

Frequency Plan for the Forward Feeder Link

The frequency band for the forward feeder link is from 28.5 to 30.0 GHz. The frequency plan is shown on the figure below.

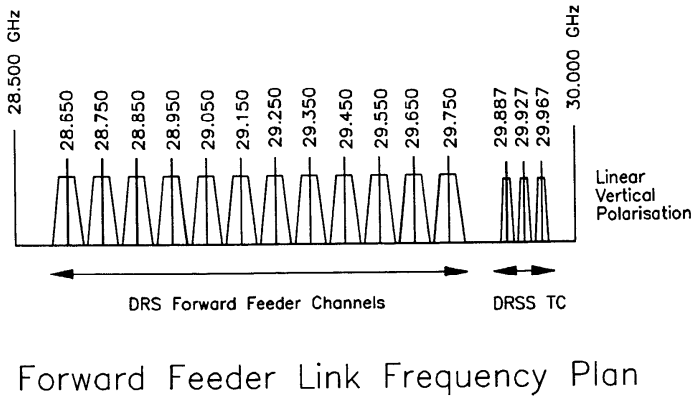

Figure 28: Forward feeder link frequency plan of Artemis

Frequency Plan for the Return Feeder Link

The frequency band for the return feeder link is from 18.1 to 20.2 GHz. The frequency plan is shown on the figure below.

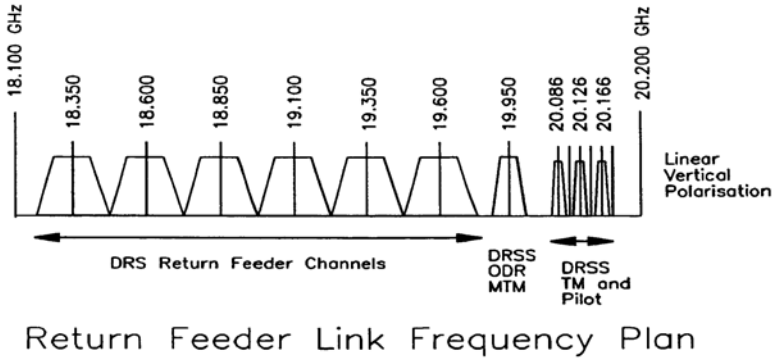

Figure 29: Return feeder link frequency plan of Artemis

3.2 In Asia

Ka band broadband satellite access has also been available in Asia with Thaicom's Ipstar and Japan's Winds satellites.

ANNEX 4 : PRESENT ITU REGULATIONS AND RELEVANT UIT-R RECOMMENDATIONS

An extract of the ITU Radio Regulations Table of Frequency Allocations for the bands 17.3-20.2 GHz is provided below.

17.3-17.7 FIXED-SATELLITE (Earth-to-space) 5.516 (space-to-Earth) 5.516A 5.516B Radiolocation 5.514	**17.3-17.7** FIXED-SATELLITE (Earth-to-space) 5.516 BROADCASTING-SATELLITE Radiolocation 5.514 5.515	**17.3-17.7** FIXED-SATELLITE (Earth-to-space) 5.516 Radiolocation 5.514
17.7-18.1 FIXED FIXED-SATELLITE (space-to-Earth) 5.484A (Earth-to-space) 5.516 MOBILE	**17.7-17.8** FIXED FIXED-SATELLITE (space-to-Earth) 5.517 (Earth-to-space) 5.516 BROADCASTING-SATELLITE Mobile 5.515	**17.7-18.1** FIXED FIXED-SATELLITE (space-to-Earth) 5.484A (Earth-to-space) 5.516 MOBILE
	17.8-18.1 FIXED FIXED-SATELLITE (space-to-Earth) 5.484A (Earth-to-space) 5.516 MOBILE 5.519	
18.1-18.4	FIXED FIXED-SATELLITE (space-to-Earth) 5.484A 5.516B (Earth-to-space) 5.520 MOBILE 5.519 5.521	
18.4-18.6	FIXED FIXED-SATELLITE (space-to-Earth) 5.484A 5.516B MOBILE	
18.6-18.8 EARTH EXPLORATION- SATELLITE (passive) FIXED FIXED-SATELLITE (space-to-Earth) 5.522B MOBILE except aeronautical mobile Space research (passive) 5.522A 5.522C	**18.6-18.8** EARTH EXPLORATION- SATELLITE (passive) FIXED FIXED-SATELLITE (space-to-Earth) 5.516B 5.522B MOBILE except aeronautical mobile SPACE RESEARCH (passive) 5.522A	**18.6-18.8** EARTH EXPLORATION- SATELLITE (passive) FIXED FIXED-SATELLITE (space-to-Earth) 5.522B MOBILE except aeronautical mobile Space research (passive) 5.522A
18.8-19.3	FIXED FIXED-SATELLITE (space-to-Earth) 5.516.B 5.523A MOBILE	
19.3-19.7	FIXED FIXED-SATELLITE (space-to-Earth) (Earth-to-space) 5.523B 5.523C 5.523D 5.523E MOBILE	
19.7-20.1 FIXED-SATELLITE (space-to-Earth) 5.484A 5.516B Mobile-satellite (space-to-Earth) 5.524	**19.7-20.1** FIXED-SATELLITE (space-to-Earth) 5.484A 5.516B MOBILE-SATELLITE (space-to-Earth) 5.524 5.525 5.526 5.527 5.528 5.529	**19.7-20.1** FIXED-SATELLITE (space-to-Earth) 5.484A 5.516B Mobile-satellite (space-to-Earth) 5.524
20.1-20.2	FIXED-SATELLITE (space-to-Earth) 5.484A 5.516B MOBILE-SATELLITE (space-to-Earth) 5.524 5.525 5.526 5.527 5.528	

Table 14: Frequency Allocations for the bands 17.3-20.2 GHz

The following provisions of the ITU Radio Regulations are applicable in the bands 17.3-20.2 GHz.

In ITU-R Region 1, the bands 17.3-20.2 GHz (space-to-Earth) and 27.5-30 GHz (Earth-to-Space) are allocated to unplanned FSS on a primary basis.

The band 17.3-18.1 GHz (Earth-to-space) is also allocated to the FSS on a primary basis and **5.516** applies: the use of this band by geostationary-satellite systems is limited to feeder links for the broadcasting-satellite service. In this band, non-geostationary-satellite systems shall not claim protection and shall not cause unacceptable interference to geostationary-satellite systems.

5.516A In the band 17.3-17.7 GHz, earth stations of the fixed-satellite service (space-to-Earth) in Region 1 shall not claim protection from the broadcasting-satellite service feeder-link earth stations operating under Appendix **30A**, nor put any limitations or restrictions on the locations of the broadcasting-satellite service feeder link earth stations anywhere within the service area of the feeder link. (WRC-03)

Within the bands 17.3-20.2 GHz and 27.5-30 GHz, the following sub-bands are identified in ITU-R Region 1 for use by high-density applications in the fixed-satellite service through **5.516B**:

17.3-17.7 GHz (space-to-Earth) in Region 1,
19.7-20.2 GHz (space-to-Earth) in all Regions,
27.5-27.82 GHz (Earth-to-space) in Region 1,
28.45-28.94 GHz (Earth-to-space) in all Regions,
29.46-30 GHz (Earth-to-space) in all Regions,

This identification does not preclude the use of these bands by other fixed-satellite service applications or by other services to which these bands are allocated on a co-primary basis and does not establish priority in these Radio Regulations among users of the bands. Administrations should take this into account when considering regulatory provisions in relation to these bands. See Resolution **143 (WRC-03)***.

The band 17.3-18.1 GHz (Earth-to-space) is also allocated to the FSS on a primary basis and 5.520 applies.
5.520 The use of the band 18.1-18.4 GHz by the fixed-satellite service (Earth-to-space) is limited to feeder links of geostationary-satellite systems in the broadcasting-satellite service. (WRC-2000)

5.484A The use of the bands 10.95-11.2 GHz (space-to-Earth), 11.45-11.7 GHz (space-to-Earth), 11.7-12.2 GHz (space-to-Earth) in Region 2, 12.2-12.75 GHz (space-to-Earth) in Region 3, 12.5-12.75 GHz (space-to-Earth) in Region 1, 13.75-14.5 GHz (Earth-to-space), 17.8-18.6 GHz (space-to-Earth), 19.7-20.2 GHz (space-to-Earth), 27.5-28.6 GHz (Earth-to-space), 29.5-30 GHz (Earth-to-space) by a non-geostationary-satellite system in the fixed-satellite service is subject to application of the provisions of No. **9.12** for coordination with other non-geostationary-satellite systems in the fixed-satellite service. Non-geostationary-satellite systems in the fixed-satellite service shall not claim protection from geostationary-satellite networks in the fixed-satellite service operating in accordance with the Radio Regulations, irrespective of the dates of receipt by the Bureau of the complete coordination or notification information, as appropriate, for the non-geostationary-satellite systems in the fixed satellite service and of the complete coordination or notification information, as appropriate, for the geostationary satellite networks, and No. **5.43A** does not apply. Non-geostationary-satellite systems in the fixed-satellite service in the above bands shall be operated in such a way that any unacceptable interference that may occur during their operation shall be rapidly eliminated. (WRC-2000)

5.519 *Additional allocation:* the bands 18-18.3 GHz in Region 2 and 18.1-18.4 GHz in Regions 1 and 3 are also allocated to the meteorological-satellite service (space-to-Earth) on a primary basis. Their use is limited to geostationary satellites. (WRC-07)

5.522A The emissions of the fixed service and the fixed-satellite service in the band 18.6-18.8 GHz are limited to the values given in Nos. **21.5A** and **21.16.2**, respectively. (WRC-2000)
5.522B The use of the band 18.6-18.8 GHz by the fixed-satellite service is limited to geostationary systems and systems with an orbit of apogee greater than 20 000 km. (WRC-2000)

5.523A The use of the bands 18.8-19.3 GHz (space-to-Earth) and 28.6-29.1 GHz (Earth-to-space) by geostationary and non-geostationary fixed-satellite service networks is subject to the application of the provisions of No. **9.11A** and No. **22.2** does not apply. Administrations having geostationary-satellite networks under coordination prior to 18 November 1995 shall cooperate to the maximum extent possible to coordinate pursuant to No. **9.11A** with non-geostationary-satellite networks for which notification information has been received by the Bureau prior to that date, with a view to reaching results acceptable to all the parties concerned. Non-geostationary-satellite networks shall not cause unacceptable interference to geostationary fixed-satellite service networks for which complete Appendix **4** notification information is considered as having been received by the Bureau prior to 18 November 1995. (WRC-97)

5.523B The use of the band 19.3-19.6 GHz (Earth-to-space) by the fixed-satellite service is limited to feeder links for non-geostationary-satellite systems in the mobile-satellite service. Such use is subject to the application of the provisions of No. **9.11A**, and No. **22.2** does not apply.

5.523C No. **22.2** shall continue to apply in the bands 19.3-19.6 GHz and 29.1-29.4 GHz, between feeder links of non-geostationary mobile-satellite service networks and those fixed-satellite service networks for which complete Appendix **4** coordination information, or notification information, is considered as having been received by the Bureau prior to 18 November 1995. (WRC-97)

5.523D The use of the band 19.3-19.7 GHz (space-to-Earth) by geostationary fixed-satellite service systems and by feeder links for non-geostationary-satellite systems in the mobile-satellite service is subject to the application of the provisions of No. **9.11A**, but not subject to the provisions of No. **22.2**. The use of this band for other non-geostationary fixed-satellite service systems, or for the cases indicated in Nos. **5.523C** and **5.523E**, is not subject to the provisions of No. **9.11A** and shall continue to be subject to Articles **9** (except No. **9.11A**) and **11** procedures, and to the provisions of No. **22.2**. (WRC-97)

5.523E No. **22.2** shall continue to apply in the bands 19.6-19.7 GHz and 29.4-29.5 GHz, between feeder links of non-geostationary mobile-satellite service networks and those fixed-satellite service networks for which complete Appendix **4** coordination information, or notification information, is considered as having been received by the Bureau by 21 November 1997. (WRC-97)

5.525 In order to facilitate interregional coordination between networks in the mobile-satellite and fixed satellite services, carriers in the mobile-satellite service that are most susceptible to interference shall, to the extent practicable, be located in the higher parts of the bands 19.7-20.2 GHz and 29.5-30 GHz.

5.526 In the bands 19.7-20.2 GHz and 29.5-30 GHz in Region 2, and in the bands 20.1-20.2 GHz and 29.9-30 GHz in Regions 1 and 3, networks which are both in the fixed-satellite service and in the mobile-satellite service may include links between earth stations at specified or unspecified points or while in motion, through one or more satellites for point-to-point and point-to-multipoint communications.

5.527 In the bands 19.7-20.2 GHz and 29.5-30 GHz, the provisions of No. **4.10** do not apply with respect to the mobile-satellite service.

5.528 The allocation to the mobile-satellite service is intended for use by networks which use narrow spotbeam antennas and other advanced technology at the space stations. Administrations operating systems in the mobile-satellite service in the band 19.7-20.1 GHz in Region 2 and in the band 20.1-20.2 GHz shall take all practicable steps to ensure the continued availability of these bands for administrations operating fixed and mobile systems in accordance with the provisions of No. **5.524**.

An extract of the ITU Radio Regulations Table of Frequency Allocations for the bands 27.5-30 GHz is provided below.

27.5-28.5	FIXED 5.537A FIXED-SATELLITE (Earth-to-space) 5.484A 5.516B 5.539 MOBILE 5.538 5.540	
28.5-29.1	FIXED FIXED-SATELLITE (Earth-to-space) 5.484A 5.516B 5.523A 5.539 MOBILE Earth exploration-satellite (Earth-to-space) 5.541 5.540	
29.1-29.5	FIXED FIXED-SATELLITE (Earth-to-space) 5.516B 5.523C 5.523E 5.535A 5.539 5.541A MOBILE Earth exploration-satellite (Earth-to-space) 5.541 5.540	
29.5-29.9 FIXED-SATELLITE (Earth-to-space) 5.484A 5.516B 5.539 Earth exploration-satellite (Earth-to-space) 5.541 Mobile-satellite (Earth-to-space) 5.540 5.542	**29.5-29.9** FIXED-SATELLITE (Earth-to-space) 5.484A 5.516B 5.539 MOBILE-SATELLITE (Earth-to-space) Earth exploration-satellite (Earth-to-space) 5.541 5.525 5.526 5.527 5.529 5.540 5.542	**29.5-29.9** FIXED-SATELLITE (Earth-to-space) 5.484A 5.516B 5.539 Earth exploration-satellite (Earth-to-space) 5.541 Mobile-satellite (Earth-to-space) 5.540 5.542
29.9-30	FIXED-SATELLITE (Earth-to-space) 5.484A 5.516B 5.539 MOBILE-SATELLITE (Earth-to-space) Earth exploration-satellite (Earth-to-space) 5.541 5.543 5.525 5.526 5.527 5.538 5.540 5.542	

Table 15: Frequency Allocations for the bands 27.5-30 GHz

The following provisions of the ITU Radio Regulations are applicable in the bands 27.5-30 GHz.

5.538 *Additional allocation:* the bands 27.500-27.501 GHz and 29.999-30.000 GHz are also allocated to the fixed-satellite service (space-to-Earth) on a primary basis for the beacon transmissions intended for up-link power control. Such space-to-Earth transmissions shall not exceed an equivalent isotropically radiated power (e.i.r.p.) of +10 dBW in the direction of adjacent satellites on the geostationary-satellite orbit. (WRC-07)

5.539 The band 27.5-30 GHz may be used by the fixed-satellite service (Earth-to-space) for the provision of feeder links for the broadcasting-satellite service.

5.535A The use of the band 29.1-29.5 GHz (Earth-to-space) by the fixed-satellite service is limited to geostationary-satellite systems and feeder links to non-geostationary-satellite systems in the mobile-satellite service.
Such use is subject to the application of the provisions of No. **9.11A**, but not subject to the provisions of No. **22.2**, except as indicated in Nos. **5.523C** and **5.523E** where such use is not subject to the provisions of No. **9.11A** and shall continue to be subject to Articles **9** (except No. **9.11A**) and **11** procedures, and to the provisions of No. **22.2**. (WRC-97)

5.541A Feeder links of non-geostationary networks in the mobile-satellite service and geostationary networks in the fixed-satellite service operating in the band 29.1-29.5 GHz (Earth-to-space) shall employ uplink adaptive power control or other methods of fade compensation, such that the earth station transmissions shall be conducted at the power level required to meet the desired link performance while reducing the level of mutual interference between both networks. These methods shall apply to networks for which Appendix **4** coordination information is considered as having been received by the Bureau after 17 May 1996 and until they are changed by a future competent world radiocommunication conference. Administrations submitting Appendix **4** information for coordination before this date are encouraged to utilize these techniques to the extent practicable. (WRC-2000)

ITU-R Recommendations relevant to the bands 27.5-30 GHz and 17.3-20.2 GHz:

S.465 Reference earth-station radiation pattern for use in coordination and interference assessment in the frequency range from 2 to about 30 GHz

S.524 Maximum permissible levels of off-axis e.i.r.p. density from earth stations in geostationary-satellite orbit networks operating in the fixed-satellite service transmitting in the 6 GHz, 13 GHz, 14 GHz and 30 GHz frequency bands

S.580 Radiation diagrams for use as design objectives for antennas of earth stations operating with geostationary satellites
S. 672 Satellite antenna radiation pattern for use as a design objective in the fixed-satellite service employing geostationary satellites

S.726 Maximum permissible level of spurious emissions from very small aperture terminals (VSATs)

S.731 Reference earth-station cross-polarized radiation pattern for use in frequency coordination and interference assessment in the frequency range from 2 to about 30 GHz

S.733 Determination of the G/T ratio for Earth stations operating in the fixed-satellite service

S.1064 Pointing accuracy as a design objective for earthward antennas on board geostationary satellites in the fixed-satellite service

S.1329 Frequency sharing of the bands 19.7-20.2 GHz and 29.5-30.0 GHz between systems in the mobile-satellite service and systems in the fixed-satellite service

S.1419 Interference mitigation techniques to facilitate coordination between non-geostationary-satellite orbit mobile-satellite service feeder links and geostationary-satellite orbit fixed-satellite service networks in the bands 19.3-19.7 GHz and 29.1-29.5 GHz

S.1428 Reference FSS earth-station radiation patterns for use in interference assessment involving non-GSO satellites in frequency bands between 10.7 GHz and 30 GHz

S.1430 Determination of the coordination area for Earth stations operating with non-geostationary space stations with respect to Earth stations operating in the reverse direction in frequency bands allocated bidirectionally to the fixed-satellite service

S.1431 Methods to enhance sharing between non-GSO FSS systems (except MSS feeder links) in the frequency bands between 10-30 GHz

S.1432 Apportionment of the allowable error performance degradations to fixed-satellite service (FSS) hypothetical reference digital paths arising from time invariant interference for systems operating below 30 GHz

S.1780 Coordination between geostationary-satellite orbit fixed satellite service networks and broadcasting-satellite service networks in the band 17.3-17.8 GHz

S.1783 Technical and operational features characterizing high-density applications in the fixed-satellite service

S.1844 Cross-polarization reference gain pattern for linearly polarized very small aperture terminals (VSAT) for frequencies in the range 2 to 31 GHz

S.1855 Alternative reference earth-station radiation pattern for antennas used with satellites in the geostationary-satellite orbit for use in coordination and/or interference assessment in the frequency range from 2 to 31 GHz

ANNEX 5 : OVERVIEW OF MAIN ITU AND CEPT REGULATIONS IN THE BANDS 17.3-20.2GHz & 27.5-30GHz

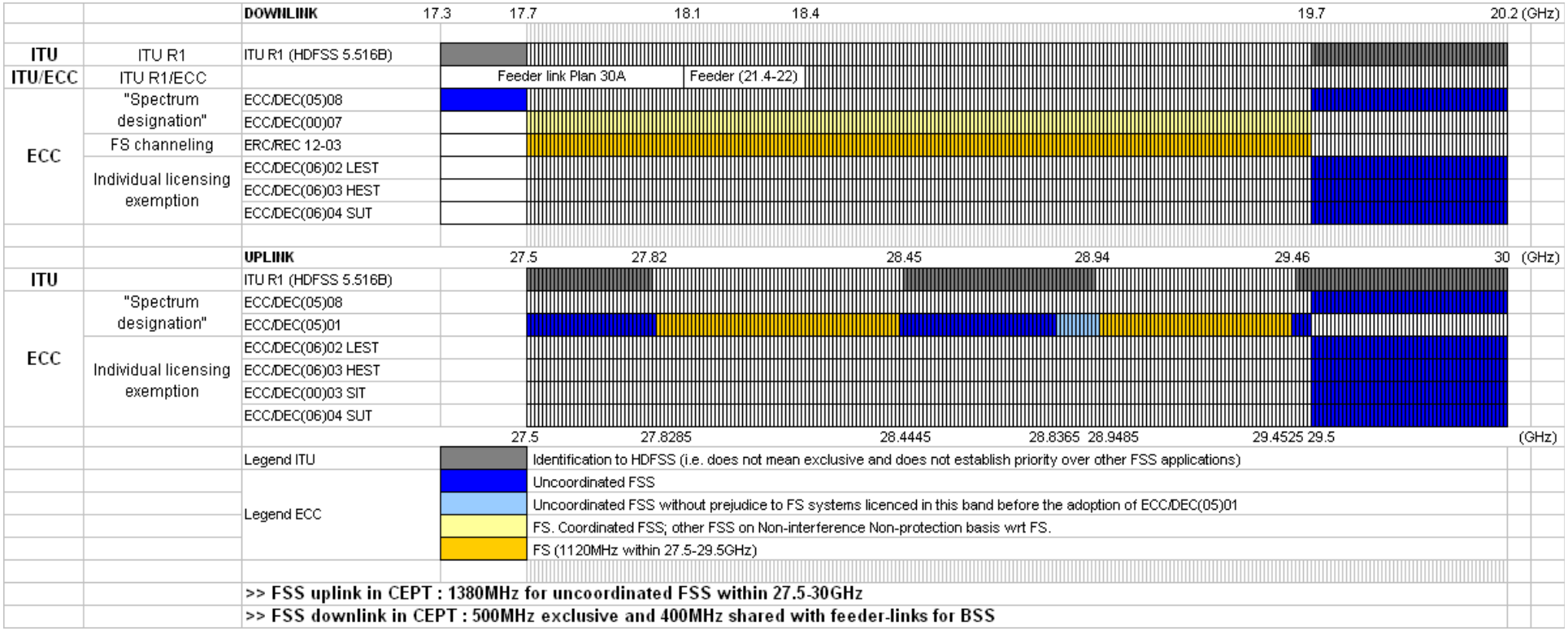

Figure 30: Overview of main ITU and CEPT regulations in the bands 17.3-20.2 GHz & 27.5-30.0 GHz

ANNEX 6 : DESCRIPTION OF FUTURE SATELLITE BROADBAND SYSTEMS AND OF FOLLOW-ON PLANS FOR A DATA RELAY SATELLITE SYSTEM IN CEPT

6.1 Broadband satellite networks

- **SES ASTRA**

The follow-up of SES ASTRA's "Broadband Interactive System" (BBI) is ASTRA2Connect (A2C) which aims at delivering services to a high number of customers, including individual users. It currently operates in Ku band but is planned to expand in Ka band to ensure a rapid and ambitious development.

- **EUTELSAT**

KA-SAT, to be launched in late 2010, will be the first European multi-beam satellite to operate exclusively at Ka band and dedicated to providing broadband and broadcast services in Europe and beyond. It will be positioned at 13 degrees East.

KA-SAT will operate simultaneously 82 spotbeams. The satellite will feature a high level of frequency re-use. The cells cover Europe and parts of the Middle East and North Africa. Frequency reuse enables the system to achieve a total capacity that is in excess of 70 Gb/s.

KA-SAT will provide an expansion for the Tooway™ consumer broadband service which was launched in 2007 via Ka band capacity available on the HOT BIRD™ 6 satellite and at Ku band via EUROBIRD™ 3.

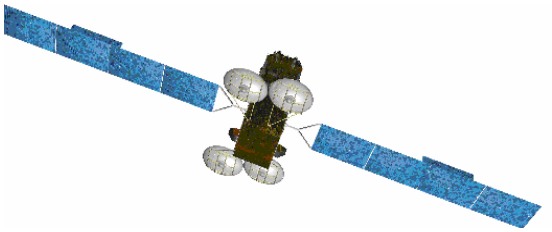

Figure 31: KA-SAT satellite

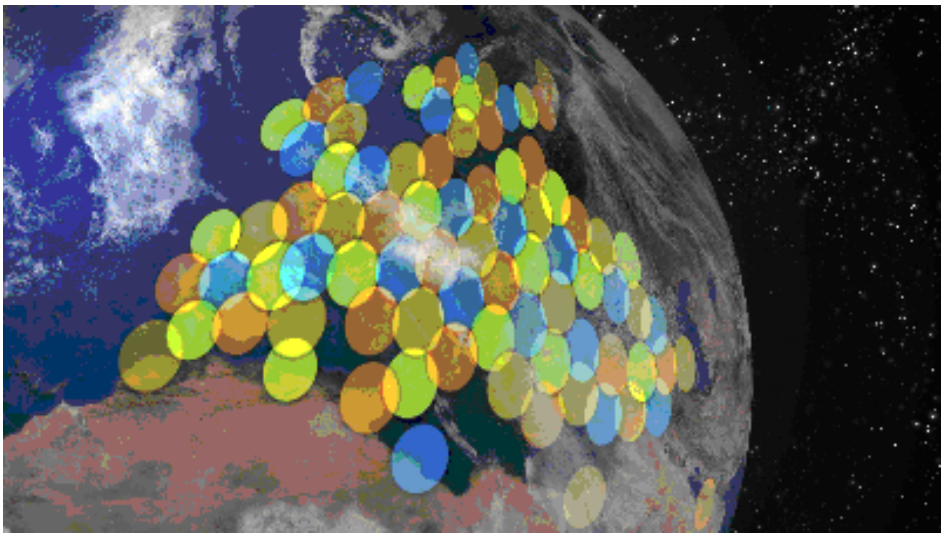

Figure 32: KA-SAT coverage

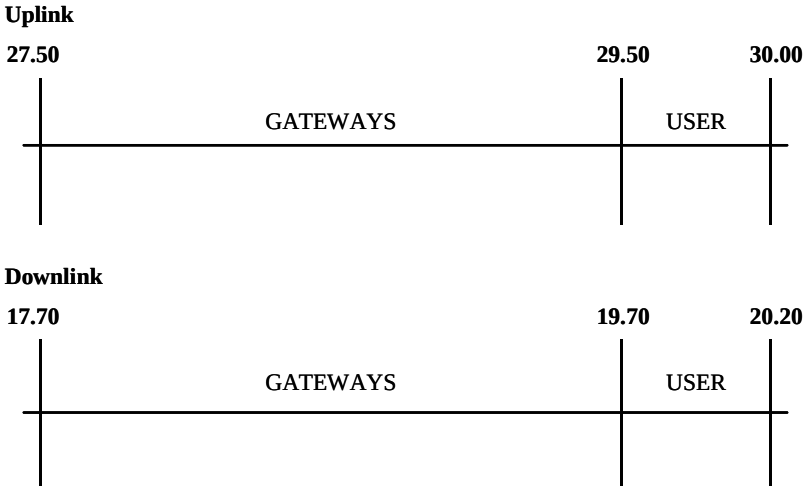

Figure 33: KA-SAT Frequency plan

- **AVANTI COMMUNICATIONS**

Avanti Communications Group (www.avantiplc.com) has procured from EADS Astrium / ISRO its first Ka band FSS / Ku band BSS satellite system called HYLAS. The HYLAS satellite system is contracted to be launched on an Arianespace provided launcher in Q2 2010. The HYLAS satellite project is an ESA supported project and employs an advanced innovative satellite payload implementation – the so-called Generic Flexible Payload (GFP) – which enables satellite power and transponder bandwidth to be flexibly allocated across the various Ka band spot beams to respond to changing market take-up patterns. The HYLAS satellite system is planned to be located at the UK 33.5W "UKDIGISAT" satellite filing location. The Ka band FSS payload of HYLAS comprises of eight active spot beams primarily aimed at providing coverage of various countries in Europe; other service areas are however technically feasible. The composite Ka band spot beam and Ku band BSS coverage for HYLAS is shown below.

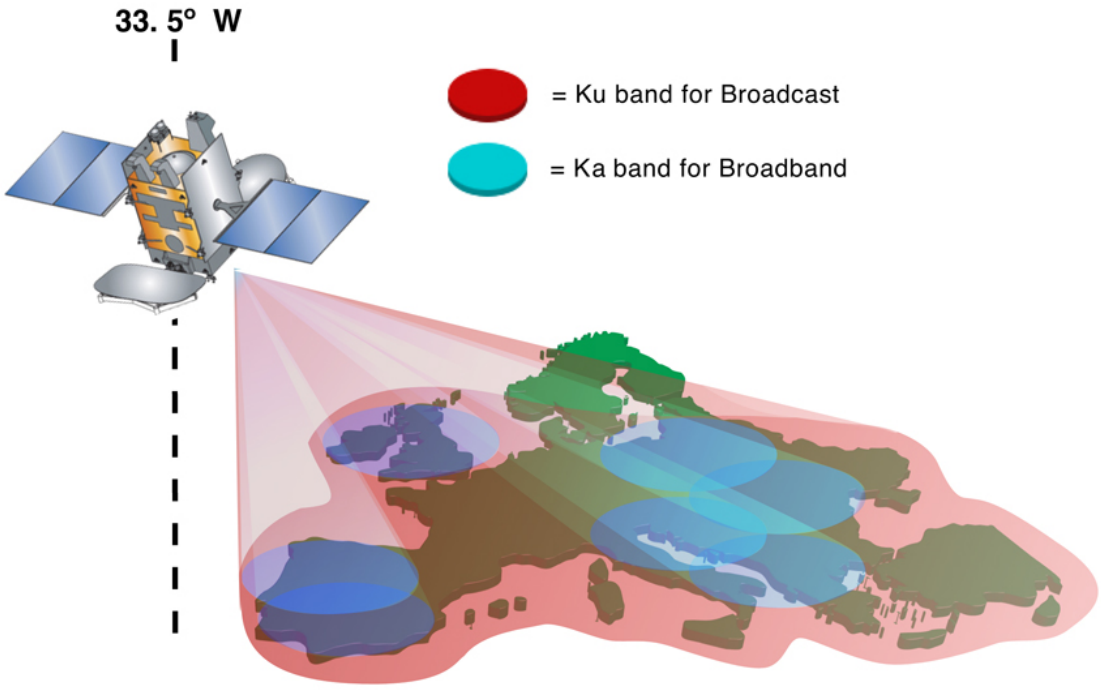

Figure 34: HYLAS Coverage

The primary mission of HYLAS is to provide 2-way Ka band satellite broadband services with the following characteristics:

- Typical use of 67 cm Satellite Interactive Terminals (SITs) / 2-4W ;
- Forward-link user data rates up to 768 kbit/sec – 10 Mbit/sec
- Return-link user data rates up to 512 kbit/sec - 4 Mbits/sec.

HYLAS can support up to 300,000 two-way broadband customers across Europe – depending on the service package mix.

The HYLAS satellite system is planned to contribute to the delivery of affordable high quality two-way broadband services in various European counties – especially in rural and remote areas.

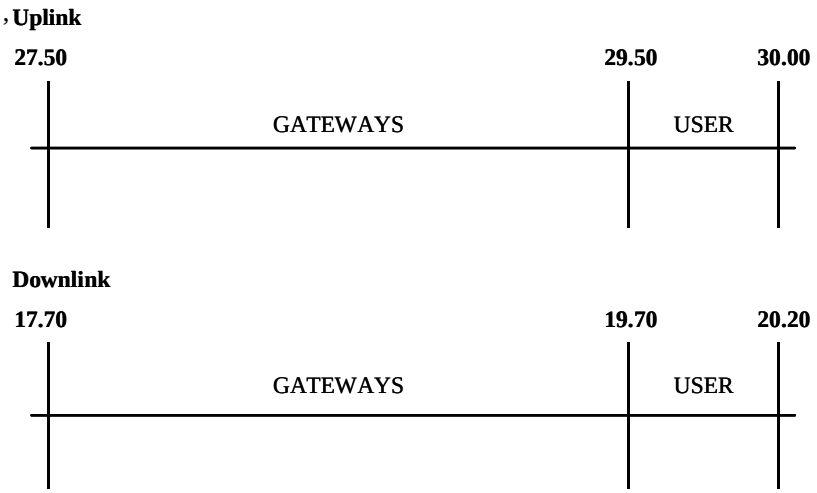

Figure 35: HYLAS Ka band FSS Frequency plan

- **EUTELSAT**

The W3B satellite is scheduled for launch in second quarter of 2010 and it will be located at 16° East. Scheduled for launch in third quarter 2011, the W3C satellite will be co-positioned with W3A at 7° East.

Both satellites will provide pan-European and pan-African coverage with connectivity between the two continents.

The Ku band will be used for the European mission and will also be used over Africa by employing frequency re-use via spatial isolation.

Since the European mission will use all the Ku band capacity, Ka band will be used for communications to and from Europe for the African mission.

The African mission will offer two services:

- The pan-African service will basically be a regional service and consequently both uplink and downlink will use Ku band over Africa.
- The African/European service will provide communication links between Africa (using Ku band) and Europe (using Ka band).

The targeted network for the African/European service will be of the star type with the hubs being in Europe and the terminals in Africa.

W3B and W3C will provide to Africa applications such as distance-learning, telemedicine, Internet access, TV broadcasting and others.

- **RSCC**

EXPRESS-AM5 and EXPRESS-AM6 satellites, to be launched in late 2012, will be the first Russian satellites having Ka band multi-beam payloads to providing broadband and broadcast services in Far East and European parts of Russia. Satellites will be located at 140 and 53 degrees east accordingly.

Ka band EXPRESS payloads will provide the operation of no less than 10 spot beams with total capacity of 15 Gbps. The spot beams cover the most populated European and eastern regions of Russia.

- **O3b**

Description of a low latency Medium Earth Orbit broadband satellite system offering broadband services to ± 45 degrees within the Equator

O3b's aim is to bridge the digital divide between nations better served and those underserved with low latency broadband services. The O3b satellite system is based on placing eight satellites equally spaced in an equatorial Medium Earth Orbit (MEO), i.e. approximately 8,000 km altitude. This allows the satellite system to delivers broadband connectivity everywhere on Earth within 45 degrees of latitude north and south of the equator. In addition, the O3b's MEO satellites achieve a round trip transmission time of less than 100 milliseconds, compared to 500 milliseconds or more taken for GSO based satellite systems.

The frequency bands to be utilized by the O3b-B satellite system are:

Frequency band	Direction of transmission
17.8 – 18.6 GHz	space to Earth
18.8 – 19.3 GHz	space to Earth
19.7 – 20.2 GHz	space to Earth
27.5 – 29.1 GHz	Earth to space
29.5 – 30 GHz	Earth to space

Table 16

The satellites are equipped with steerable antennas and have the ability to remain locked onto a fixed location on Earth as the satellite passes overhead. The first constellation of eight satellites is expected to be launched in early 2012. The teleports (gateways) of O3b are expected to be located in Europe and elsewhere around the world.

The O3b system is transport agnostic, supporting all traffic payloads, with scalable data rates from 1Mbps to 10 Gbps, while offering seamless integration with existing network architecture.

6.2 Feeder applications for the provision of high data rate services

- **ESA artemis data relay satellite system follow-on plans**

The European Commission has launched the GMES (Global Monitoring for Environment and Security) initiative. This is the European Initiative for the establishment of a European capacity for Earth Observation.
GMES will provide decision-makers who rely on strategic information with regard to environmental and security issues with an independent and permanent access to reliable data. GMES pre-operational services were launched in 2008, with the objective to move into the operational phase in 2011.
This initiative requires the deployment of a constellation of several Earth Observation satellites collecting the required data from space. The responsibility for this element lies with ESA.

Beside the development of this satellites constellation, ESA plans to use Artemis to provide the required data relay services.

This will:

- increase the capability to downlink payload data from these satellites;
- increase the satellites coverage without resorting to high on-board data storage;
- reduce the data latency (time between the satellite measurement and its availability to the users);
- improve the capability to control the satellites from the ground.

In order to provide this service also in the long-term, ESA has started the development of new data relay satellites within a programme called EDRS (European Data Relay Satellite). The satellites developed under this programme may have feeder links in the same bands as Artemis. Alphasat TDP-1 (also known as EDRS-B) will be an element of EDRS and do not have the same feeder-link band than Artemis; most of them will be in portions of the Ka band not covered by this report. No decision yet has been taken on EDRS-A and EDRS-C. These satellites will initially co-operate with Artemis and eventually will replace it, when the satellite will come to the end of its operational life.

ANNEX 7 : REFERENCES

[1] European Radiocommunications Office
http://www.ero.dk/

[2] European Common Allocations Database
http://apps.ero.dk/ECA/

[3] Industry Canada, Authorized and Approved Canadian Satellites
http://www.ic.gc.ca/eic/site/smt-gst.nsf/eng/sf05343.html

[4] SES
http://www.ses.com/ses/

[5] Eutelsat
http://www.eutelsat.com/fr/home/

[6] Wildblue
http://www.wildblue.com/

[7] Viasat
http://www.viasat.com/

[8] O3b
http://www.o3bnetworks.com/

[9] RSCC
http://www.rscc.ru/